EXHIBIT 4

Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit

Prepared for
Bell Legal Group
219 Ridge Street
Georgetown, SC 29440

Prepared by

Norman L. Jones
Norm Jones Consulting LLC
4174 N 430 E
Provo, UT 84604

R. Jeffrey Davis
Integral Consulting Inc.
2231 E Murray Holladay Road
Suite 201
Salt Lake City, UT 84117

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ACRONYMS AND ABBREVIATIONS

ATSDR	Agency for Toxic Substances and Disease Registry
PCE	tetrachloroethylene
GMS	Groundwater Modeling System
MAE	mean absolute error
ME	mean error
NGWA	National Groundwater Association

1 SUMMARY OF OPINIONS

The opinions presented in this report are in response to the portion of the Alexandros Spiliotopoulos report related to the post-audit we performed on the Agency for Toxic Substances and Disease Registry (ATSDR) flow and transport models for Tarawa Terrace. Our opinions are as follows:

Opinion 1: The Spiliotopoulos report exaggerated and distorted the model bias in the post-audit results.

Opinion 2: The calibration target of ±0.5 order of magnitude used in the original ATSDR transport study was arbitrary and too narrow to use as a basis for evaluating the post-audit results.

Opinion 3: Spiliotopoulos did not effectively refute our qualitative assessment of the overall plume behavior.

Opinion 4: The numerical roundoff errors found by Spiliotopoulos were minor and did not significantly impact the model results.

Opinion 5: The pumping rate error and the mass loading termination date error found by Spiliotopoulos were both minor and did not significantly impact the model results.

Opinion 6: Nothing in the Spiliotopoulos report contradicts our overall conclusion about the post-audit results. The model effectively simulates long-term trends in contaminant migration, and we can find no significant evidence that would invalidate the analyses performed by ATSDR with the original model.

All of the opinions expressed in this rebuttal report are held by both of us. Our opinions are based on our review of the report of Dr. Spiliotopoulos, the ATSDR published reports, the references listed in this report and our Oct. 2024 report, our post-audit, and our experience and expertise in the fields of hydrogeology and groundwater modeling. We hold these opinions to a reasonable degree of scientific and engineering certainty.

2 INTRODUCTION

Our names are Norman L. Jones and R. Jeffrey Davis, and we have been asked to provide a rebuttal to a set of expert reports issued on December 9, 2024, related to the Camp Lejeune Water Litigation. Based on our review of these reports, we have reached the conclusions and opinions set forth below. A list of all materials considered to form the opinions in this rebuttal will be produced within seven days of the report's submittal. Our conclusions are subject to any new materials, data, or other information provided to us prior to depositions or trial, at which time our opinions and conclusions may be updated.

In July 2007, ATSDR, U.S. Department of Health and Human Services, published a report on a groundwater flow and transport model of the Tarawa Terrace region of the Camp Lejeune military base (Maslia et al. 2007; Faye and Valenzuela 2008; Faye 2008). The model was developed to simulate groundwater flow in the aquifers beneath Tarawa Terrace and to simulate the migration of tetrachloroethylene (PCE)[1] in the aquifers resulting from the release of PCE by ABC One-Hour Cleaners, which is directly adjacent to the northern boundary of the Tarawa Terrace property. The original Tarawa Terrace flow model was designed to simulate flow conditions over a period from 1951 to 1994. Output from the model was used to estimate the PCE concentration at the Tarawa Terrace Water Treatment Plant as part of an epidemiological study.

In 2024, we were tasked with performing a post-audit of the Tarawa Terrace flow and transport model.[2] The objective of the post-audit was to extend the range of the groundwater flow and transport model from 1995 to 2008 and compare the output of the transport model with concentrations sampled at monitoring wells in Tarawa Terrace during the 1995–2008 period to assess the performance of the model as an interpretive and predictive tool. This comparison involved both a quantitative analysis of simulated versus observed concentrations and a qualitative analysis of the shape and migration of the simulated PCE plume over that period. On October 25, 2024, we submitted a report of this effort titled *Tarawa Terrace Flow and Transport Model Post-Audit* (Jones and Davis, 2024). After performing the post-audit, we concluded:

> *In summary, this post-audit found that the original Tarawa Terrace groundwater flow and transport models were developed using sound methodology and continue to provide reliable insights into the migration of PCE contamination. Despite the inherent challenges in simulating complex subsurface conditions and dealing with incomplete data, the model effectively simulates long-term trends in contaminant migration. Based on this*

[1] PCE is also known by other names, including tetrachloroethene. In this report we refer to it as PCE.

[2] The Tarawa Terrace groundwater model consists of a MODFLOW model to simulate flow and a coupled MT3DMS model to simulate PCE transport in the aquifer. Depending on context, in this report we will occasionally refer to the coupled MODFLOW/MT3DMS simulations as a singular "model" and in some cases we will refer to the two simulations as "models."

> *post-audit, we can find no significant evidence that would invalidate the analyses performed by ATSDR with the original model.*

On December 9, 2024, we were provided with the following three reports by experts hired by the U.S. Department of Justice:

1. Expert Report of **Alexandros Spiliotopoulos**, PhD. In the United States District Court for the Eastern District of North Carolina. No. 7:23-cv-897. In Re: Camp Lejeune Water Litigation. S.S. Papadopulos & Associates, Inc. December 9, 2024.

2. Expert Report of **Remy J.-C. Hennet**. In the United States District Court for the Eastern District of North Carolina. No. 7:23-cv-897. In Re: Camp Lejeune Water Litigation. S.S. Papadopulos & Associates, Inc. December 9, 2024.

3. Expert Report of **Jay L. Brigham**, PhD. In the United States District Court for the Eastern District of North Carolina Southern Division. Case No.: 7:23-CV-897. Camp Lejeune Water Litigation. Morgan, Angel, Brigham and Associates, LLC. December 9, 2024.

Of the three reports, the only one that directly referenced our 2024 post-audit was the Spiliotopoulos report. The objective of this document is to respond to issues raised in relation to our post-audit. Therefore, we will only reference the Spiliotopoulos report in the following sections.

3 RESPONSE TO SPECIFIC ITEMS IN THE ALEXANDROS SPILIOTOPOULOS REPORT

3.1 ASSESSING THE PERFORMANCE OF CONTAMINANT TRANSPORT MODELS

Before responding to specific issues raised in the Spiliotopoulos report, it would be useful to review some basic facts related to evaluating the performance of groundwater models in general, and more specifically to contaminant transport models.

3.1.1 Accuracy, Precision, and Model Fitting

In Section 3 of the Spiliotopoulos report, there is a discussion of general principles of model calibration, sensitivity, and uncertainty analysis. In the context of the discussion, the graphic shown in Figure 1 was presented (referenced as Figure 2 of the Spiliotopoulos report). This graphic was reproduced from a document produced by the National Oceanic and Atmospheric Administration to illustrate the concepts of "precision" and "accuracy" as they relate to natural sciences (NOAA 2024).

While this graphic may apply to some concepts of natural sciences, it presents a grossly unrealistic standard for the modeling of physical phenomena that exhibit a high degree of variance, as is the case with PCE concentrations at a contaminated site. For such cases, the graphics in our Figure 2 represent a more appropriate and realistic depiction of the modeling process. The red dots shown in Figure 2(a) represent a set of observations sampled in the field representing some physical phenomenon. The sample values are on the y-axis and the x-axis represents a variable such as distance or time. The red data points exhibit a high degree of scatter or variance. This could be the result of sampling error or variability, or some kind of local-scale heterogeneity that is a natural byproduct of the phenomenon in question. Despite the variance, the points show a general trend of decreasing y-values as the x-values increase. The blue line in Figure 2(a) represents a simple model that accurately captures the behavior of the phenomenon. The green dashed line in Figure 2(b) represents an alternative model that attempts to model the phenomenon represented by the red dots with a high degree of precision. This is a classic case of what is referred to as "model overfitting." Even though it has less "precision," the blue line in Figure 2(a) is a much more appropriate model. For example, if a second set of samples were obtained over the same x-domain, one would expect to see the same downward trend, but the data points would be different. The blue line in Figure 2(a) would still be a good fit to the second data set, but the green dashed line in Figure 2(b) would be a very poor fit.

The dangers of model overfitting and the importance of finding a balance between simple and complicated models in the field of groundwater modeling has been highlighted by a number of

respected groundwater researchers, including Carrera and Neuman (1986), Hill (2006), Hunt, et al. (2020), Yeh and Yoon (1981), Wali et al. (2024), and Zatlakovic et al. (2023). Hunt et al. (2020, p. 176) stated:

> *The highly parameterized approach often achieves an excellent fit but can also "overfit," where the parameter estimation chases noise in the observations and yields unrealistic parameter values and distributions (e.g., parameter "bullseyes," or hotspots).*

Mary Hill's research in particular underscores the importance of balancing model complexity with the risk of overfitting (Hill 1998, 2006, 2010). She advocates for starting with simpler models and gradually increasing complexity, allowing for a more accurate representation of the system without capturing extraneous noise. This approach not only aids in avoiding overfitting but also enhances the model's predictive reliability.

3.1.2 Contaminant Concentrations Exhibit High Variance

The concepts illustrated in Figure 2 are important to understand in the context of a post-audit of the ATSDR Tarawa Terrace model. The PCE concentrations measured at the Tarawa Terrace site exhibit a high degree of variance. Figure 3 illustrates a histogram of the observed PCE values taken from observations wells at Tarawa Terrace used in the post-audit. The histogram is based on log-transformed values, indicating that data are log-normally distributed and vary over 5 orders of magnitude. Furthermore, as we explained in Section 4.2 of our post-audit report, a careful analysis of the observed concentrations from Tarawa Terrace shows high variance in the form of temporal and spatial anomalies. Some samples collected at similar times in wells separated by a short distance showed a high degree of variance. In other cases, samples taken at the same observation well but separated by a relatively short time also exhibited high variance.

High spatial and temporal variability in observed PCE concentrations results from a number of factors. Variations in sampling methods, equipment, and processing can lead to variation. Aquifer heterogeneity can also have a significant impact. Consider the conceptual diagram shown in Figure 4. At the local-scale, groundwater flow is not uniform. Groundwater preferentially flows through high permeability channels (shown in blue) and there is minimal flow in low permeability zones (shown in brown). Thus, a monitoring well screen that happens to coincide with a preferential flow channel (point B) may sample a substantially different concentration than a sample taken from a monitoring well that happens to be screened in a low permeability zone (point A).

The issue of high variability in PCE concentrations at Camp Lejeune was discussed at length by the Expert Panel convened by ATSDR to assess its methods and analyses for historical reconstruction. It noted that concentration measurements can vary greatly over short periods of time (ATSDR 2009c, p. 216). For example, wellhead concentrations can fluctuate significantly within a 2-week period. One well showed a high of 1,600, followed by 540, and

then 300 μg/L in subsequent samples (ATSDR 2009c, p. 121). There were concerns about the representativeness of individual samples due to the limitations of sampling procedures and laboratory analyses (ATSDR 2009b, p. 336; ATSDR 2009c, p. 217). It was noted that some of the observed PCE data may be biased low due to collection activities, and adjustments may be needed (ATSDR 2009c, p. 62). Because of this high variance, the panel suggested that instead of trying to match the model to every data point, it may be more useful to focus on capturing the general trends in the data and suggested using ranges of concentration to convey uncertainty rather than single values (ATSDR 2009d, p. 69).

3.1.3 Transport Models versus Flow Models

The diagram in Figure 2 is representative of the complexities inherent in simulating the transport of contaminants such as PCE in aquifers. By its nature, computer modeling of contaminant transport is substantially different from modeling groundwater flow, and calibrating transport models presents unique challenges (Zheng et al. 2012; Green et al. 2010). For a groundwater flow model, the primary variable simulated is the hydraulic (potentiometric) head. While there is some level of variance in hydraulic head, it is significantly less variable than contaminant concentrations. Heads are normally distributed, not log-normally distributed, and they do not vary by multiple orders of magnitude. The process of sampling heads at observation wells has a much lower possibility of error, and heads are much less sensitive to local-scale heterogeneity. For these reasons, when calibrating a flow model or assessing the performance of a flow model, one would expect lower variance in the observations and therefore lower residuals (difference between simulated and observed heads) at observation wells. Zheng et al. (2012, p. 1551) state:

> *To users of MT3DMS, the term "model calibration" generally describes a process in which the model structure and parameter values are adjusted, either manually or by using formal mathematical optimization procedures, until the model output satisfactorily matches a set of targets (Zheng and Bennett, 2002). The suggestion by Hill and Tiedeman (2007) that "satisfactory" needs to be considered in the context of data errors and model limitations is important to users of MT3DMS because of difficulties associated with simulating subsurface transport. Difficulties include the inaccessibility of subsurface systems and the many order of magnitude range of concentration values that can occur in the data set for a single site.*

Another difference between flow models and transport models is that a flow model simulates the spatial and temporal distribution of hydraulic heads throughout the entire saturated zone of an aquifer. By contrast, a transport model simulates the migration of a contaminant plume that occupies a small fraction of the spatial extent of the aquifer. For the majority of the aquifer, the concentration is equal to zero. Simulated concentrations can vary from high concentrations inside the plume to zero concentrations outside the plume. Thus, if the spatial extent of the simulated plume differs from the spatial extent of the actual plume at certain locations due to

issues such as local-scale aquifer heterogeneity, the residuals can be large even though the general shape, trajectory, and timing of the plume is reasonably accurate.

3.1.4 Qualitative and Quantitative Assessment of Model Performance

For all of these reasons, when conducting an assessment of the performance of a transport model, one has to factor in the high variance of the concentration measurements and the unique nature of contaminant transport models. As we explained in our post-audit report, it is important to assess transport models using a qualitative analysis in addition to a quantitative analysis. A quantitative analysis may show high variance in the model residuals, but does the model do a reasonable job of simulating the overall shape, magnitude, and movement of the plume? This can be assessed by analyzing maps of plume migration versus time to see if the residuals are balanced spatially and temporally as we did in Section 5.2 of the post-audit report. Furthermore, examining the average error over the entire simulation can be a way of assessing the overall fit. If this error is low, the model has done a reasonable job of fitting the highly variable observation data, similar to the fit of the blue line in Figure 2(a).

3.2 OPINION 1—BIAS IN POST-AUDIT RESULTS

One of the primary claims made by Spiliotopoulos about the post-audit results is that the post-audit showed that the model has a high positive bias, indicating that the model-simulated concentrations are generally higher than those observed at the observation wells (see Section 4.1.5.1 of the Spiliotopoulos report). In our original post-audit report, we presented data relating to how well the extended simulation matched the larger set of PCE observations collected after the original ATSDR study. These data included tables of simulated and observed PCE concentrations at observation wells, the overall mean residual error (simulated – observed concentrations), scatter plots of simulated versus observed concentrations at individual wells, a scatter plot of all of the simulated versus observed data pairs, simulated versus observed time series at individual wells, and a series of plume maps showing the temporal and spatial distribution of residual error. However, in arguing for high bias, Spiliotopoulos seemed to focus primarily on a qualitative assessment of Figure 6 from the post-audit report, which is the simulated versus observed scatter plot. This figure is repeated in the left panel of Figure 5. The Spiliotopoulos report also noted some issues in the post-audit with model inputs and post-processing, which we respond to in detail below in Sections 3.5 and 3.6. Two of these issues relate to minor errors in the model inputs, which we corrected and then produced an updated simulation, as described in Section 3.7, below. The other issue was with the truncation of numerical precision in the simulated PCE results. This issue also had a relatively small impact on the overall model results. However, one artifact of the truncation error is that all simulated PCE concentrations lower than ~17 μg/L were truncated to 0 μg/L, which accounts for the lack of scatter points in the lower half of the original scatter plot shown in the left panel of Figure 5. Using the updated simulation results and ensuring that the results were processed at full precision, we recreated the scatter plot, and the results are shown in the right panel of

Figure 5. While the numbers indicate a high degree of variance, they are visually more balanced than the results we originally presented in the post-audit report.

In Section 4.1.5.1 of the Spiliotopoulos report, he generated a new plot of the post-audit results in an attempt to highlight model bias. This was presented in his report as Figure 19, and it was a ranked order plot where simulated and observed pairs were plotted using a sample ranking method where the pairs are ranked from high to low in terms of the observed value (reproduced here as Figure 6). The right side of this plot showed a large number of simulated values greater than the observed values, especially for a number of locations where the observed values are equal to zero. We have recreated this plot in the upper panel of Figure 7 using the same methodology used by Spiliotopoulos, but in this case, we used the updated simulation results with full precision. Once again, the plot shows more simulated values in the 0–17 μg/L range, showing more balance. In addition, we created a second ranked order plot, but this time the ordering was performed in relation to the simulated values, rather than the observed values. The results are shown in Figure 7, lower panel. This plot is visually more balanced than the ranking based on observed values.

In Section 3.1.2, above, we discussed how and why the observed PCE concentrations exhibit a high degree of variance. When comparing model results to an observation data set that exhibits a high variance, one of the most important factors is the overall mean error (ME). The ME is found by calculating the average residual error (simulated PCE – observed PCE) for the entire data set. For the original post-audit results we calculated an ME value = 21 μg/L, indicating an extremely balanced fit with only a small high bias. For the updated post-audit results, the ME = 48 μg/L, indicating a small increase in the bias, but still relatively well balanced overall. This balance indicated by the ME value was largely ignored by Spiliotopoulos.

The objective of the original model was to simulate the aggregate concentration of PCE at the Tarawa Terrace Water Treatment Plant over a 30-year period. Matching highly-variable observed PCE concentrations at specific points in time and space will result in high residuals. However, if the overall model fit is balanced, the simulated concentrations, which are drawn from water pumped from a significant portion of the aquifer over a long period of time, should exhibit much lower variability.

Spiliotopoulos also noted that the simulated versus observed data set for the post-audit model includes many simulated-observed pairs where either a) the observed value is zero and the simulated value is non-zero, or b) the simulated value is zero and the observe value is non-zero. This result is not surprising for several reasons. First, as described in our post-audit report, there are several cases in the observed PCE concentration data set where two samples taken at the same time but only separated by a short spatial distance exhibited significantly different values, including a zero value for one sample and a large value for the other sample. In other cases, samples taken at the same observation well but separated by a few months in time, exhibited similar differences. These anomalies could be due to local-scale aquifer heterogeneity, sampling error, etc. Furthermore, a transport model generates a solution over a numerical grid consisting of cells with representative averaged parameter values. This

approach inherently smooths the simulated results. The actual contaminant plume might follow preferential flow paths, resulting in zones where the sample values are zero, whereas the simulated plume is more continuous due to the smoothing effect of the grid. This does not indicate that the model is inaccurate, but that the model is representing an aggregate condition of the aquifer using representative parameter values.

Opinion 1: The Spiliotopoulos report exaggerated and distorted the model bias in the post-audit results.

3.3 OPINION 2—CALIBRATION TARGETS AND VARIABILITY

In several of the simulated versus observed plots generated by Spiliotopoulos, he overlaid lines creating a narrow band around the line of equality corresponding to a calibration target of 0.5 order of magnitude (see Figure 6 for an example), and implied that the post-audit results indicate a poor fit because many of the simulated versus observed PCE values do not fall within this window. Before discussing that specific calibration target, it is helpful to review the concept of a calibration target in general.

When calibrating a groundwater model, it is customary to define a calibration target. For a flow model, this would be defined in terms of piezometric head (water table elevation). For example, a calibration target of 5 m would mean that the goal would be to have the simulated heads within ±5 m of the observed heads. This could be evaluated both in terms of simulated versus observed heads for each observation or for global error norms (mean absolute error [MAE], root-mean squared error, etc.). For a transport simulation, it is more customary to define calibration targets in terms of orders of magnitude due to the high variance in both simulated and observed values. For example, a 1.5 order of magnitude calibration target would mean that residual errors are computed in terms of log-transformed concentrations and the interval is ±1.5 orders of magnitude (log scales).

The concept of a calibration target is based on a recognition that it is impractical for a groundwater simulation to exactly match field observations for several reasons. First of all, the observations themselves are subject to variability resulting from measurement errors, differences in methods for processing lab samples, uncertainty in monitoring well elevations, errors in sampling methodology, etc. Furthermore, the interval also takes into account that constructing a computer model involves a large number of simplifying assumptions. It is impossible to fully characterize and incorporate all parameters and complexities of a real aquifer system in a discretized computer model. Given these considerations, the determination of an appropriate calibration target would theoretically require a) an accurate assessment of the uncertainty or variability of the sampling error, and b) an accurate characterization of the numerical impact of the simplifying assumptions and uncertainties of the model parameters used to build the model. One could then use these numbers to develop a calibration target perfectly tailored to the modeling exercise at hand. In practice, both of these numbers are impossible to obtain. Therefore, a calibration target is ultimately a subjective “goal” for the

calibration exercise derived as an educated guess by the modeling team. Ultimately, the calibration process continues until additional adjustments to the modeling parameters no longer improve the goodness of fit between the simulated and observed values (the overall error cannot be reduced further). Whether or not the calibration target was met is generally a secondary concern.

While the original ATSDR model was calibrated using a target of ±0.5 order of magnitude, there was no indication of how this target was developed, and ultimately many of the PCE concentration residuals were outside the range of the calibration target (53%). For the transport model, the calibration process was continued until a good overall balance was achieved. The resulting simulated concentrations at the Tarawa Terrace Water Treatment Plant were compared with the measured concentrations, and a reasonable agreement was found. The National Research Council review of the ATSDR modeling studies noted that the calibration target was arbitrary:

> *The modeling studies did not include any formal analysis to account for the temporal or spatial data-averaging effects. Instead, in the analysis presented by Faye (2008), the point measurements were used to set a "calibration target range" for constraining the model predictions; the range was arbitrarily set at about half the order of magnitude of the detected point measurements (Faye 2008).*
> *(*NRC 2009, p. 46*)*

> *The basis used for setting the values of the "calibration target range" was unclear.*
> (NRC 2009, p. 49)

Furthermore, during the 2009 expert panel assessment of the ATSDR study there were comments provided by panel members regarding the approach of setting calibration targets (ATSDR 2009d). Panel member, Dr. Mary Hill said:

> *There is no one set of established guidelines, but there has been much effort internationally in pursuit of such guidelines.*
> *(*ATSDR 2009d*, p. 96)*

> *In the DON review it is noted that the ASTM guidelines mention a priori definition of a model fit criteria. To my knowledge it is not common in practice and is not a practice I would recommend. For the TT model, it seems to me that a priori definition of a model fit criteria lead to unrealistic expectations of model accuracy."*
> *(*ATSDR 2009d, p. 96*)*

Panel member, Dr. Rao Govindaraju stated:

> *To the best of my knowledge, there are no accepted protocols for setting calibration targets. Typically, one sets calibration targets* based on the available data and the goals of the study. Since the purpose of this modeling exercise is to reconstruct concentration

> histories for use in an epidemiological *study, the modeling study should provide an estimate of human exposure. Ideally, this goal should decide the calibration targets."*
> *(ATSDR 2009d, p. 85)*

Panel member, Dr. Konikow stated:

> *Overall, there are no standards and probably should not be any. Such targets are inevitably arbitrary and to some extent meaningless. They tend to distract from the quality of the calibration process and shift focus to the arbitrary goal. It is a "red herring." Not achieving a predetermined calibration target should not disqualify a model, nor does that prove a model is not valuable or useful. Conversely, meeting such a predetermined calibration target does not prove that the model is a good one or that it meets the needs of the particular study or that its calculations and predictions are accurate and/or reliable.*
>
> *In my opinion, the use of specific calibration targets should be abandoned.* They have no real value in the context of hydrogeology, and can only serve to provide a false or meaningless image of the quality of the developed model.
> *(ATSDR 2009d, p. 101)*

Ultimately, the ATSDR Expert Panel recommended against the use of a calibration target:

> *Overall, the panelists did not agree with the calibration criterion ATSDR planned to use. The panel suggested ATSDR not pre-specify numerical values of calibration targets. There was consensus among panel members that emphasis should be placed on more objectively estimating model parameters than on trying to closely match observed water-level or concentration data with model-simulated results for model calibration."*
> (ATSDR 2009d, p. 2)

The U.S. Navy said the following in its review of the ATSDR study:

> *Navy recognizes the variability in the field data, and this kind of variability is expected. In our experience at many hundreds of sites across the country, measured concentrations of contaminants in groundwater vary significantly and somewhat unpredictably over time."*
> (U.S. Navy 2009, p. 4)

In the ATSDR response to the U.S. Navy review, it noted a similar study on chlorinated organic compounds at U.S. Naval Air Station in Jacksonville, Florida (ATSDR 2009a). This study was peer-reviewed by the U.S. Geologic Survey (Davis 2003). In this case, even though the model was calibrated and later used as a predictive tool (Davis 2007), no calibration target was ever established or used to gauge the accuracy of the model, consistent with our point above that calibration targets are generally arbitrary.

Opinion 2: The calibration target of ±0.5 order of magnitude used in the original ATSDR transport study was arbitrary and too narrow to use as a basis for evaluating the post-audit results.

3.4 OPINION 3—QUALITATIVE ASSESSMENT OF PLUME BEHAVIOR

One of the main conclusions of our original post-audit report was that given the high variability in observed PCE concentrations, it is important to assess the overall behavior of the simulated PCE plume relative to the observations. Specifically,

> *Given these challenges, it is important to qualitatively assess the overall behavior of the simulated plume in addition to quantitatively analyzing the differences in simulated and observed concentrations at specific times and locations. A qualitative evaluation helps ensure that the model captures the key processes governing plume migration, such as its general direction, spread, and interaction with sources, sinks, and aquifer boundaries. This broader perspective can offer valuable insights into the overall value of the model as an interpretive or predictive tool.*
> (Jones and Davis 2024, p. 5-1.)

One of the methods we used to achieve this was to overlay the residual errors for the observation points with plume maps at multiple model layers and at multiple points in time. With the exception of a few wells with known anomalies, this analysis indicated a good overall agreement between the simulated PCE plume and the observed concentrations over the range of the extended simulation.

This point was largely ignored by Spiliotopoulos. He addressed it only briefly and superficially at the bottom of p. 63 of his report. He critiqued our qualitative assessment of plume behavior, stating it is "unhelpful" due to significant discrepancies between observed and simulated concentrations, the small area of comparison, and the lack of data to evaluate the overall plume extents. This critique is limited and weak because it ignores the inherent challenges of contaminant transport modeling and dismisses a valuable approach to model evaluation.

The Spiliotopoulos report claims that comparisons are drawn within a very small area compared to the overall plume extents. However, the observation wells are concentrated in the area around the extraction wells used to feed the water treatment plant, which is also the area where the main part of the PCE plume is located. As our report states, this is the area where the concentrations ultimately impact the concentrations at the water treatment plant, making it the most important area from which to have observations. It is not necessary to have observations covering the entire modeling domain, which is impractical and cost prohibitive.

The Spiliotopoulos report notes that no data are available to evaluate whether the overall extents of the simulated plume are realistic. However, the lack of data outside the primary area of concern is a common challenge in contaminant transport modeling. It does not invalidate

the model's usefulness for assessing the plume behavior in the area of interest, which is where the impact on human health is most likely. Our post-audit used the available data to assess model performance, which is a valid approach and based on sound scientific methodology and accepted within the scientific community.

Opinion 3: Spiliotopoulos did not effectively refute our qualitative assessment of the overall plume behavior.

3.5 OPINION 4—ISSUES WITH POST-PROCESSED RESULTS

In Section 4.1.5.2 of his report, Spiliotopoulos also identified some anomalies with the post-processed results. Specifically, he noticed that for some wells we reported identical concentrations over a series of observation dates. He also recreated simulated concentrations at well RWC-2 and overlaid the simulated PCE concentrations for selected dates and showed that our simulated concentrations were of the right overall magnitude but exhibited a stair-step behavior. He also noted that in Figure 11 of our original report, we showed well S9 as being on the fringe but still inside the simulated PCE plume, yet we reported a zero concentration for well S9 at the date corresponding to the plume map (3/1/2003).

We investigated this issue and discovered the cause of the anomaly. In one of the steps we used to post-process the simulated PCE values, we inadvertently truncated the PCE values down to a low number of significant digits. This resulted in a “round-off” error where some of the simulated PCE values were too high and some were too low. This error only applied to the simulated PCE values at the observation well locations and not to the overall MT3DMS simulation results as shown in the PCE plume maps in Figures 9–16 in the post-audit report.

We reprocessed our original post-audit simulation results and the full precision numbers are shown in Table 1 along with the original truncated values. Fortunately, the magnitude of the roundoff error was relatively small and mostly balanced. The mean truncation error was −1.47 μg/L, the maximum absolute truncation error was 17.5 μg/L, and the mean absolute truncation error was 7.2 μg/L. The mean residual error from the original set of truncated values was 21 μg/L, and for the full precision data set, the recalculated mean residual error was 22 μg/L, indicating a minimal overall impact as the residual errors are still balanced.

One artifact of the truncation error is that it was most pronounced with the low magnitude concentrations. As a result, any simulated concentration lower than ~17.5 μg/L was truncated to zero. This caused our simulated versus observed PCE concentration plot to show fewer simulated–observed points below the line of equality in Figure 6 of the post-audit report, as described above. This also explains the discrepancy noted by Spiliotopoulos for well S9 in the plume map shown in Figure 11 of our post-audit report. We reported a simulated PCE value of zero for 3/1/2003, but the full precision value = 15.7 μg/L, which is why it plotted as inside the PCE plume in Figure 11 of the post-audit report.

Opinion 4: The numerical roundoff errors found by Spiliotopoulos were minor and did not significantly impact the model results.

3.6 OPINION 5—MODEL INPUT ERRORS

In Section 4.1.5.2 of his report, Spiliotopoulos identified an issue with two of the inputs to our post-audit model files.

3.6.1 Extended Model Timeframe

Spiliotopoulos noted that our report indicates that the source term in the extended model terminates in December 1983, and he checked the extended model input files to confirm that the source term in the input files indeed matched that date. He is correct that the original ATSDR report on the Tarawa Terrace MT3DMS simulation (Faye 2008) states that the source term was terminated in December 1984. This was an error in Source-Sink Mixing (SSM) package input file to the extended MT3DMS simulation used in the post-audit. We corrected the error and ran a new simulation. The updated simulation results are discussed in Section 3.6.3 below.

3.6.2 Pumping Rate for Well RWC-2

Spiliotopoulos also noted that Table 2 of our post-audit report stated a pumping rate of 40 gallons per minute (gpm) for well RWC-2 from 3/7/2004 through 12/16/2004. However, the input files for the extended simulation show a pumping rate of 20 gpm for this well for this time period. This was an error in the Well Package input file to the extended MODFLOW simulation used in the post-audit. We corrected the error and ran a new simulation. The updated simulation results are discussed in Section 3.6.3 below.

3.6.3 Updated Simulation Results

We have corrected both input errors and generated new MODFLOW and MT3DMS simulations. Table 2 shows the simulated PCE values at each monitoring well location from the original model, the simulated PCE concentrations from the updated model, and the difference between the two. The updated PCE concentrations are processed at the full numerical precision as discussed in Section 3.5, which accounts for a portion of the concentration differences.

The pumping rate error was small and only impacted a few months in 2004. Correcting the termination of the mass loading by changing it from the end of December 1983 to the end of December 1984 had a larger impact and increased the PCE concentration to some degree at most of the well locations. The average increase was 27 μg/L. Accordingly, the mean residual error increased from 21 to 48 μg/L. This indicates a small high bias, but the overall errors are still reasonably balanced.

To further illustrate the magnitude of the differences between the two simulations, we have generated a PCE time series for the grid cell containing well TT-26 using the original and updated post-audit results (Figure 8). The updated simulation has slightly higher concentrations from about 1990 onward.

We have also generated new versions of each of the tables and figures from our original post-audit report featuring simulated PCE values, using the updated post-audit simulation results, processed at full precision. These results are presented in Appendix A. The differences in the tables and figures relative to the original report are relatively minor overall. The differences are summarized as follows:

Appendix	Post-Audit	Differences
Table A1	Table 5	Mean increase of 27 mg/L as explained above.
Table A2	Table 6	Modest increase in ME and MAE. Of the 37 sites, 5 changed categories (see explanation below for Figures A10, A11, and A12).
Figure A1	Figure 2	No significant differences.
Figure A2	Figure 6	Differences noted previously in Section 3.2.
Figure A3	Figure 7	Various differences, mostly minor. See summary in Table 2.
Figure A4	Figure 8	Various differences, mostly minor. See summary in Table 2.
Figure A5	Figure 9	June 1997 plume map. Of 20 observations, 2 changed categories: S2 changed from green to yellow (141 µg/L → 208 µg/L), and S1 changed from yellow to red (494 µg/L → 505 µg/L).
Figure A6	Figure 10	February 2000 plume map. Of 21 observations, 1 changed category: S10 changed from yellow to red (494 µg/L → 503 µg/L).
Figure A7	Figure 11	March 2003. Of 27 observations, 3 changed categories: RWS-1A changed from green to yellow (171 µg/L → 265 µg/L), RWS-2A changed from green to yellow (148 µg/L → 280 µg/L), and S3 changed from green to yellow (164 µg/L → 256 µg/L).
Figure A8	Figure 12	March 2006. There were 30 observations. No changes.
Figure A9	Figure 13	March 2008. Of 26 observations, 1 changed category: FWC-11 changed from yellow to red (494 µg/L → 515 µg/L).

Appendix	Post-Audit	Differences
Figure A10	Figure 14	December 2008 (overall MAE) – layer 1. Of 18 sites, 4 changed categories: FWS-12 changed from green to yellow (176 μg/L → 218 μg/L), RWS-1A changed from green to yellow (142 μg/L → 207 μg/L), RWS-2A changed from green to yellow (190 μg/L → 301 μg/L), and S5 changed from yellow to red (462 μg/L → 528 μg/L).
Figure A11	Figure 15	December 2008 (overall MAE) – layer 3. Of 17 sites, 1 changed category: C2 changed from yellow to red (423 μg/L → 519 μg/L).
Figure A12	Figure 16	December 2008 (overall MAE) – layer 5. There were 2 sites. No changes.

Opinion 5: The pumping rate error and the mass loading termination date error found by Spiliotopoulos were both minor and did not significantly impact the model results.

3.7 OPINION 6—POST-AUDIT ROBUSTNESS

In summary, while Spiliotopoulos did correctly point out some issues with our post-processing and model inputs for the original post-audit results, the impact of these errors was relatively minor. Spiliotopoulos exaggerated the magnitude of the model bias and ignored the fact that the errors are mostly balanced. His use of the ±0.5 order of magnitude calibration is arbitrary and overly restrictive.

This rebuttal underscores the robustness of the original post-audit findings for the Tarawa Terrace Flow and Transport Model. Despite critiques raised by Spiliotopoulos, the analyses validate that the extended model continues to reliably simulate the migration of PCE contamination over the extended period from 1995 to 2008. Our qualitative and quantitative assessments demonstrate that the model captures the key dynamics of PCE plume migration while accommodating the inherent complexities and high variances in observed concentrations. These findings support our original conclusion that the ATSDR model was developed using a methodology that is scientifically sound and accepted within the scientific community, and it remains a reliable tool for assessing the impacts of PCE contamination at Tarawa Terrace.

Opinion 6: Nothing in the Spiliotopoulos report contradicts our overall conclusion about the post-audit results. The model effectively simulates long-term trends in contaminant migration, and we can find no significant evidence that would invalidate the analyses performed by ATSDR with the original model.

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5 QUALIFICATIONS

I, **R. Jeffrey Davis**, P.E., CGWP, have almost 30 years of experience with civil and environmental engineering, hydrogeology, groundwater fate and transport modeling, and software and model development. I have both undergraduate and graduate degrees from Brigham Young University in civil engineering. I currently serve on the board of directors for the National Ground Water Association (NGWA), as well as on NGWA's per- and polyfluoroalkyl substances and Managed Aquifer Recharge advisory groups. I was one of the leads for NGWA's Groundwater Modeling Advisory Panel. I have developed and used numerous groundwater models for the agricultural industry and the mining industry, including projects involving environmental impact statements, environmental assessments, water management, groundwater–surface water interaction and contamination, dewatering, and water treatment. I also have extensive experience with the oil and gas industry, including water supply, hydraulic fracturing, and groundwater protection for the upstream market, and worked on a variety of oil release projects. I have extensive knowledge of groundwater flow-and-transport principles and have led numerous workshops and classes in the United States and around the world. I have taught several classes and workshops in association with NGWA and other professional organizations and universities for the past 3 decades. I also share my research and project work regularly with the professional societies with which I am affiliated. I frequently use groundwater models to explain fate and transport of contaminants or groundwater supplies and availability. Recent such examples include groundwater impacts from agricultural activities in Minnesota; aqueous film-forming foam contamination impacts to groundwater in Martin County, Florida; a pipeline of produced water spill in North Dakota; and groundwater availability and surface water impacts in Ventura County, California. I am regularly asked to provide opinions or participate on panels to discuss groundwater, water supply, or contaminated groundwater issues.

I, **Norman L. Jones**, Ph.D., have 33 years of experience in civil and environmental engineering. I graduated with a B.S. degree in civil engineering from Brigham Young University and with M.S. and Ph.D. degrees in civil engineering from the University of Texas at Austin. I have been a faculty member in the Civil and Construction Engineering Department at Brigham Young University since January 1991 where I currently hold the rank of Professor. I have taught university courses in a variety of subjects, including computer programming, soil mechanics, seepage and slope stability analysis, and groundwater modeling. The primary focus of my research has been groundwater flow and transport modeling, software development, remote sensing, groundwater sustainability analysis, and hydroinformatics. I was the original developer of the Groundwater Modeling System (GMS) software, which is a graphical user interface for MODFLOW and MT3DMS and is used by thousands of organizations all over the world. GMS is now developed and maintained by Aquaveo, LLC in Provo, Utah, a company that I helped found in 2007. I have taught numerous short courses on groundwater flow and transport modeling over my career. I am a member of the Hydroinformatics Research Laboratory at Brigham Young University. I have been the principal or co-investigator on more

than $20M of externally funded research. I have authored 179 technical publications, including 88 peer-reviewed journal articles, and 1 book. I am a recipient of the Walter L. Huber Civil Engineering Research Prize from the American Society of Civil Engineers and the John Hem Award for Science and Engineering from NGWA. I have been involved in a number of consulting projects, including work as a technical expert in litigation cases. I am an active member of the American Water Resources Association, the NGWA, the American Geophysical Union, and the American Society of Civil Engineers.

6 COMPENSATION

My, **R. Jeffrey Davis**, experience is summarized in my resume, which is included as Exhibit 1. I am being compensated at a rate of $498 an hour for my time in preparation of this report and $498 an hour for my deposition and trial testimony, if necessary. My compensation is not contingent upon the opinions I developed or the outcome of this litigation case.

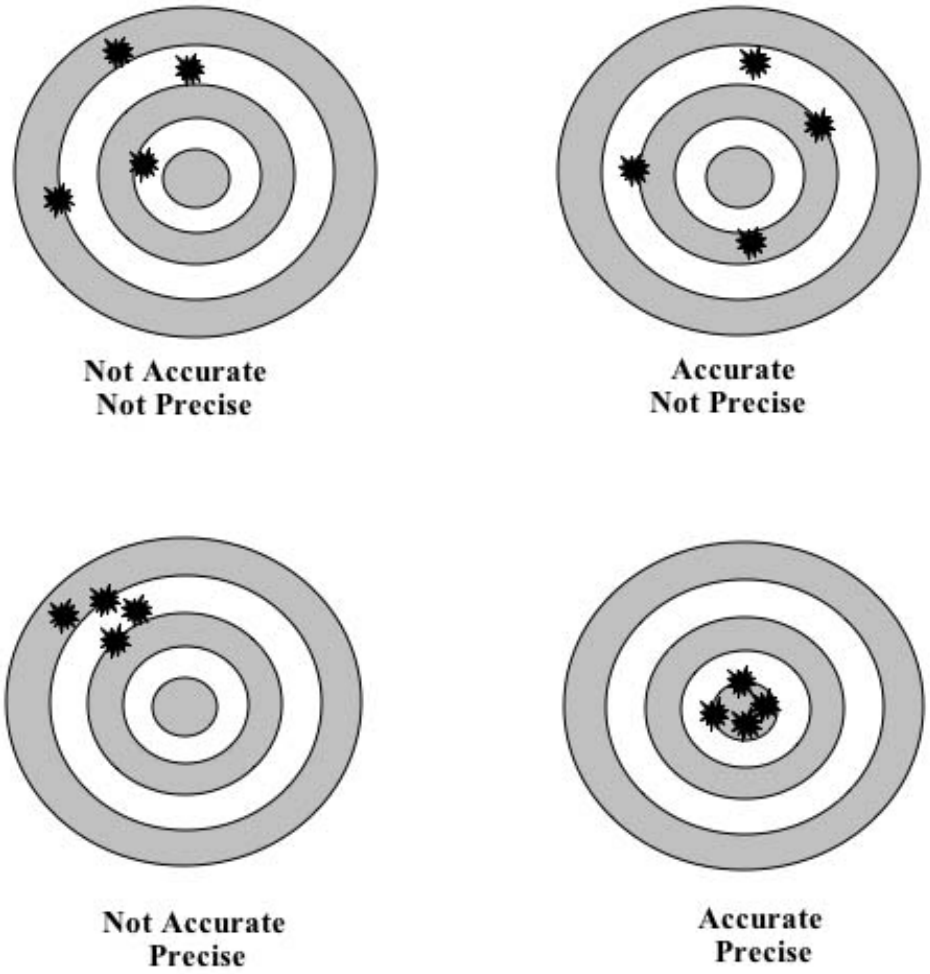
My, **Norman L. Jones**, experience is summarized in my resume, which is included as Exhibit 2. I am being compensated at a rate of $500 an hour for my time in preparation of this report and $1,000 an hour for my deposition and trial testimony, if necessary. My compensation is not contingent upon the opinions I developed or the outcome of this litigation case.

7 PREVIOUS TESTIMONY

I, **R. Jeffrey Davis**, have not given any deposition or trial testimony in the last 4 years.

I, **Norman L. Jones**, gave deposition testimony on October 20, 2021, in MICHAEL YATES and NORMAN L. JONES vs TRAEGER PELLET GRILLS LLC, in the United States District Court for the District of Utah Central Division, Case No. 2:19-cv-00723-BSJ. With the exception of this case, I have not given any deposition or trial testimony in the last 4 years.

Figures



Source: https://celebrating200years.noaa.gov/magazine/tct/tct_side1.html

integral

Figure 1.
Accuracy vs. Precision Graphic
Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit

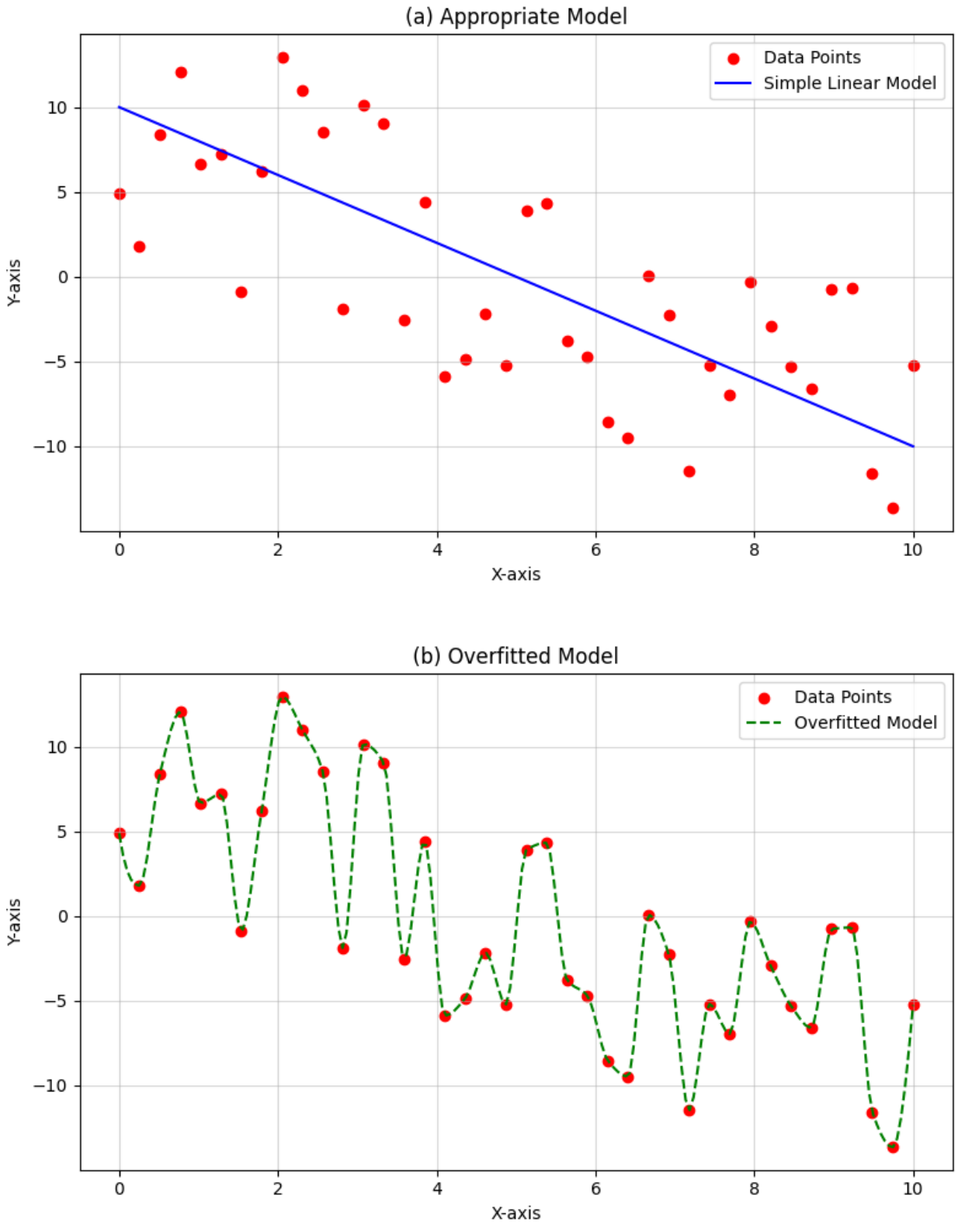


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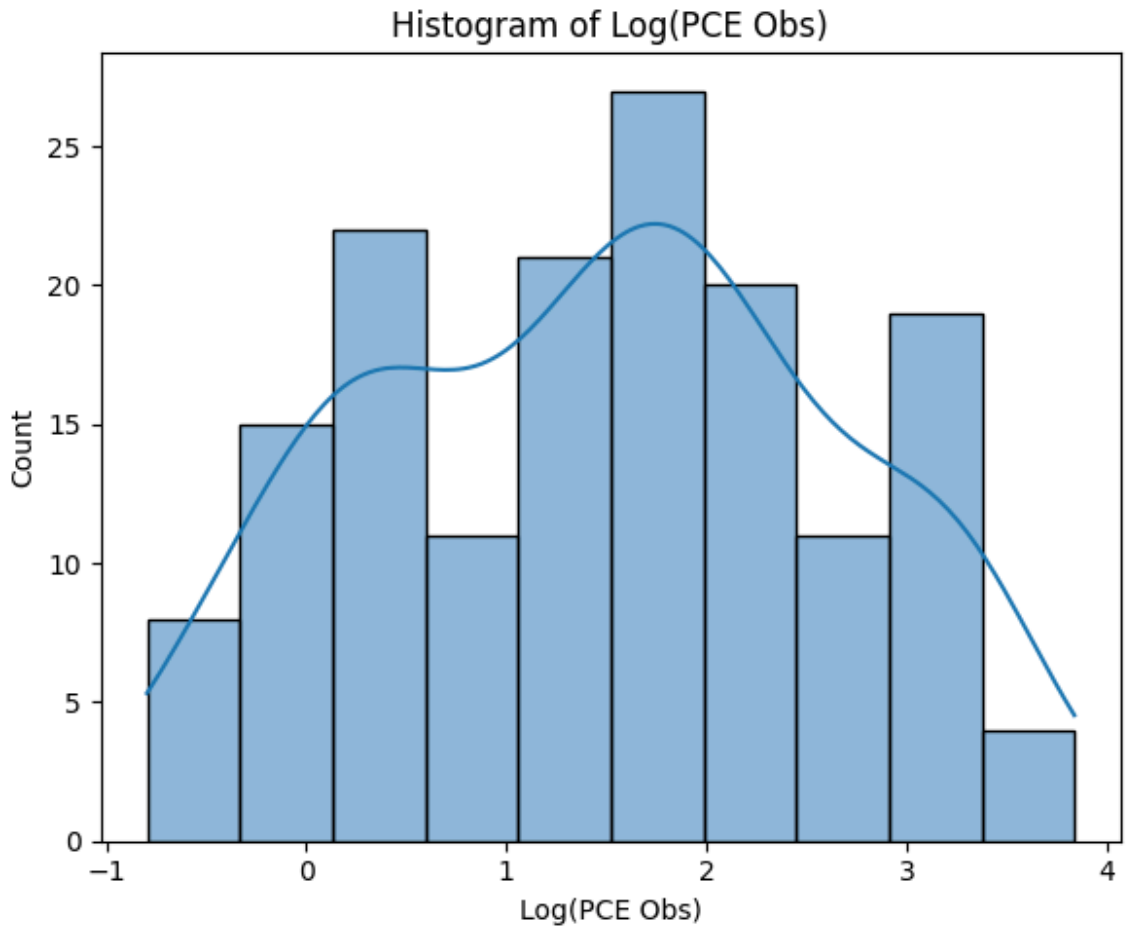
Figure 2.
Model Fitting of High Variance Data
Rebuttal Report Regarding Tarawa Terrace
Flow and Transport Model Post-Audit



Note:
Log PCE observations are provided in µg/L.
PCE = tetrachloroethylene

integral

Figure 3.
Histogram of Log-Transformed PCE in Observation Wells at Tarawa Terrace
Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit

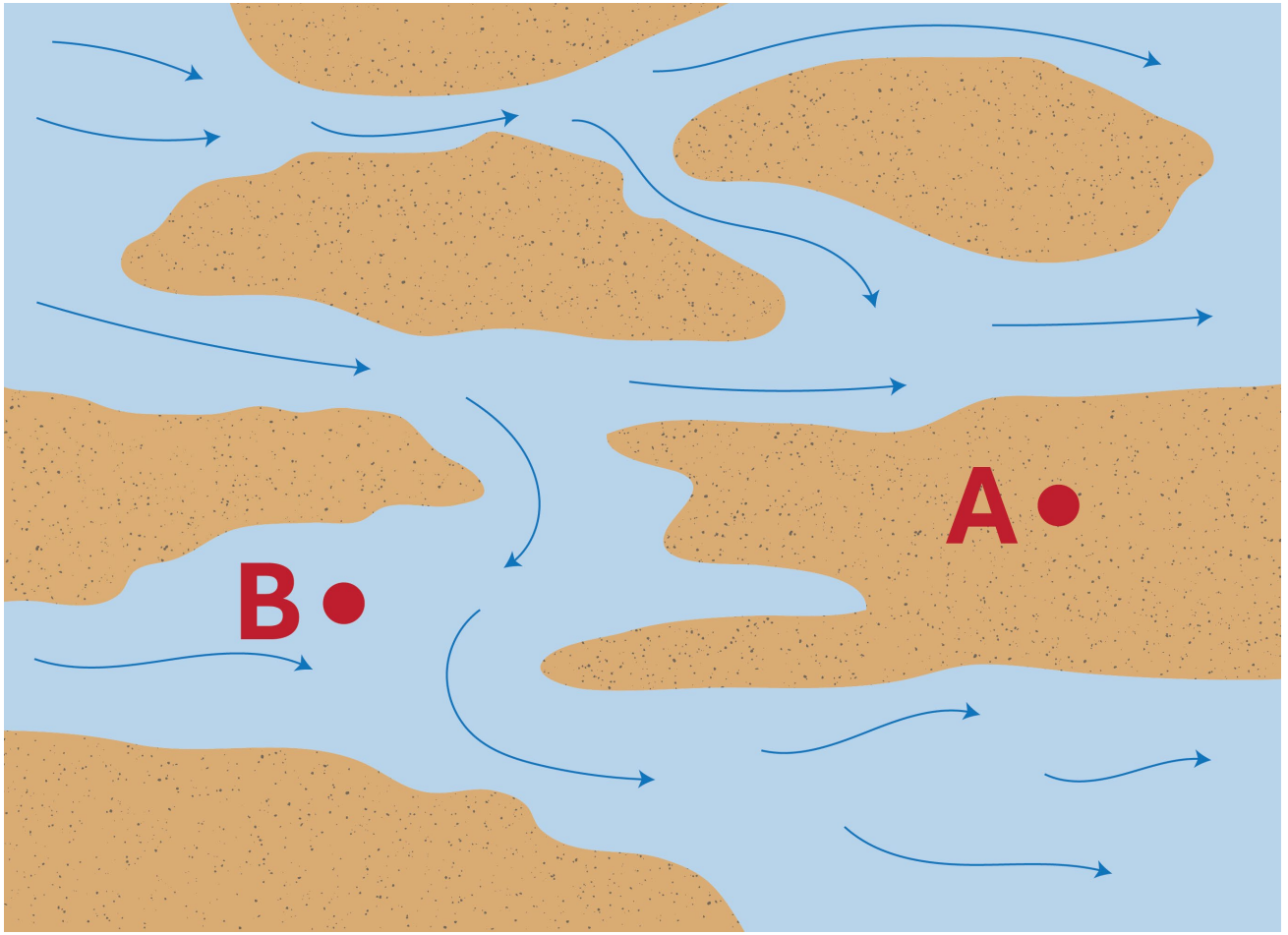


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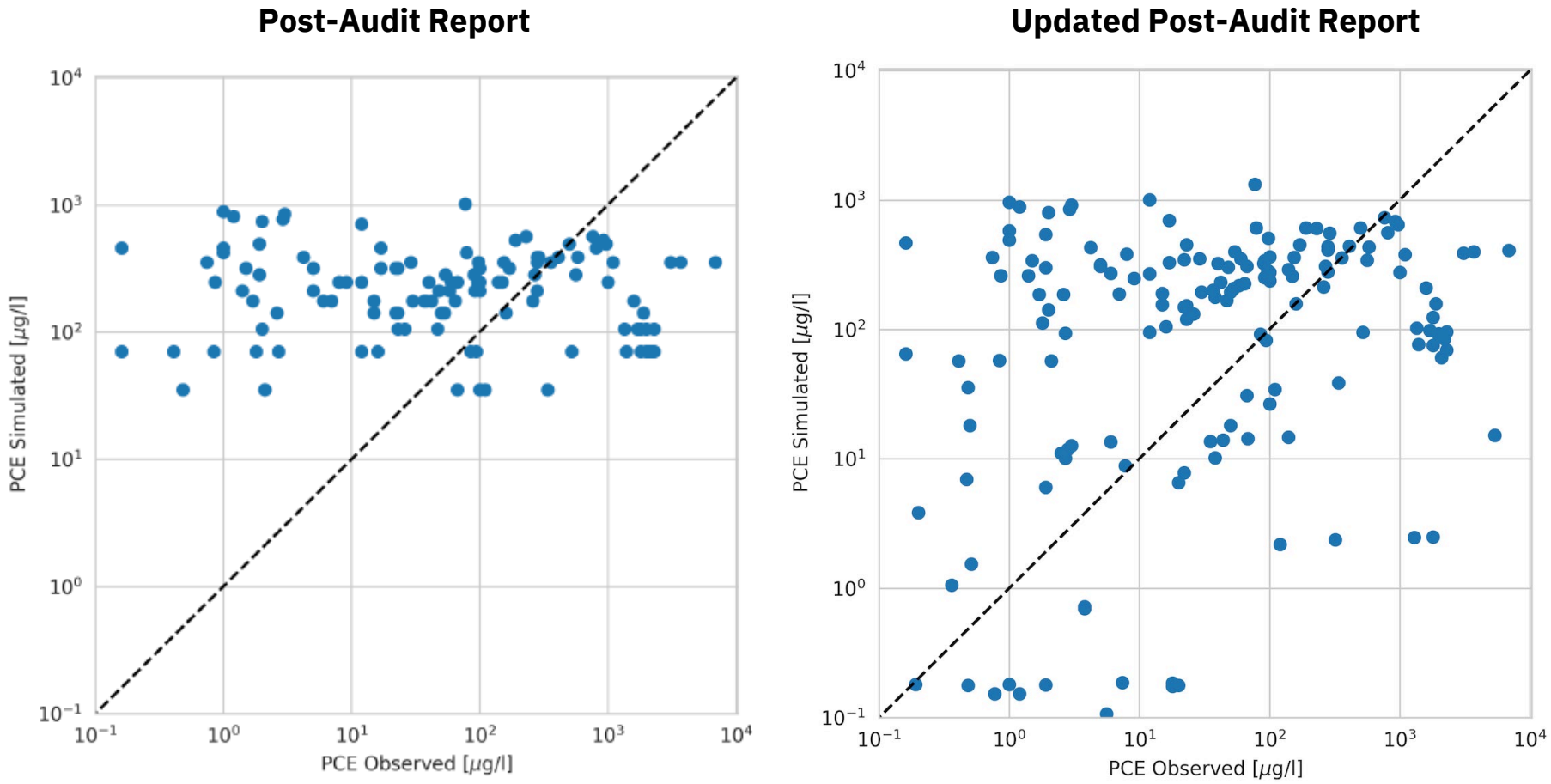
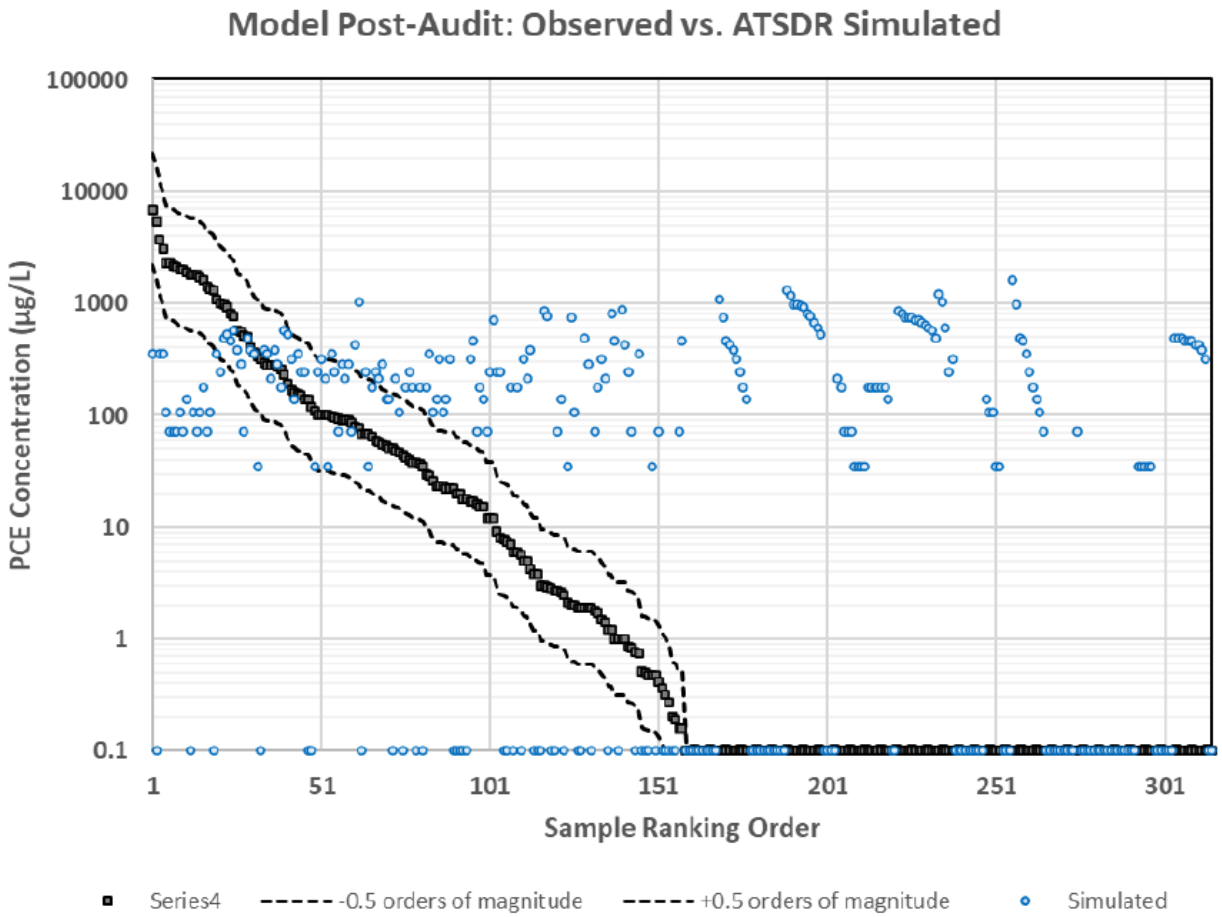
Figure 4.
Conceptual Representation of Local-Scale Aquifer Heterogeneity
Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit



Note:
PCE = tetrachloroethylene

integral

Figure 5.
Simulated vs. Observed PCE Concentrations
Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit

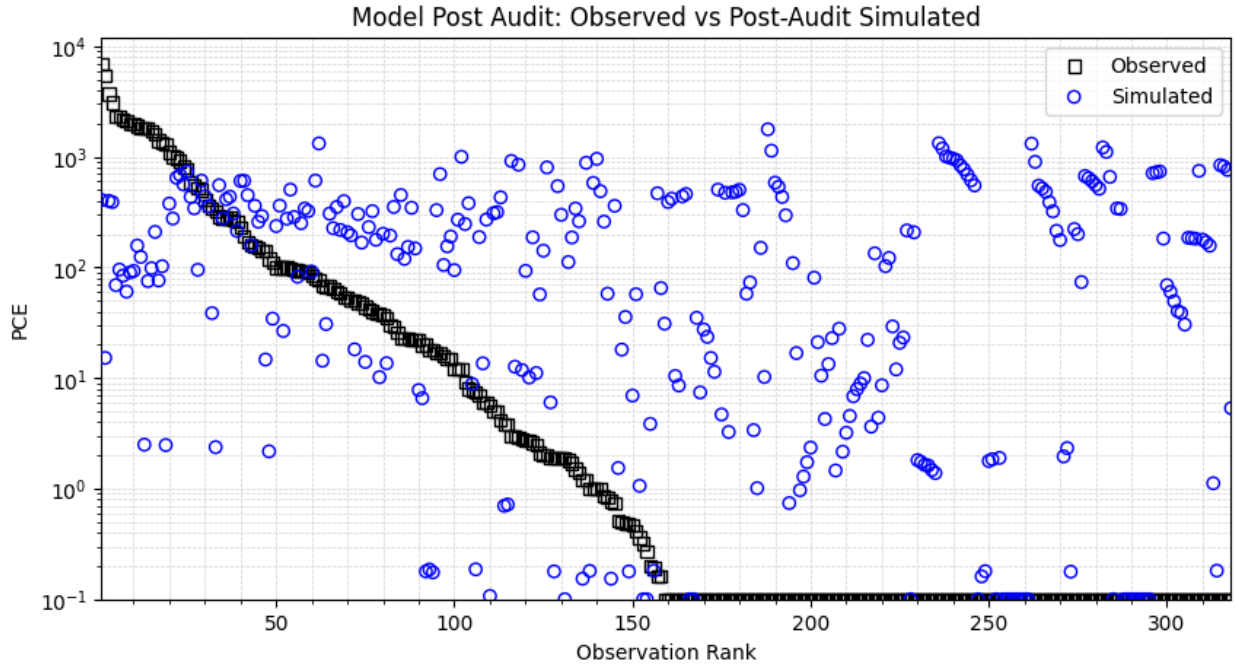


Notes:
PCE = tetrachloroethylene
Source: Spiliotopoulos Report, Figure 19

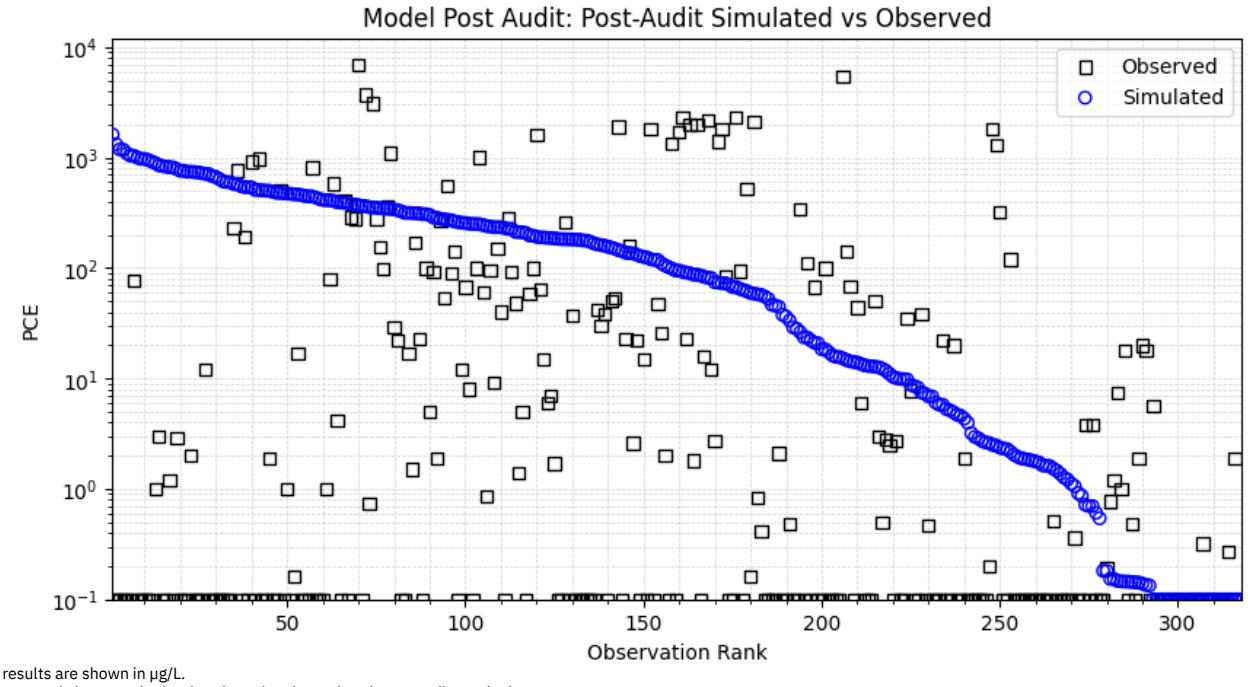
integral

Figure 6.
Ranked Order Plot Produced by Spiliotopoulos Using the Original Post-Audit Data
Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit

Decreasing Observed Value

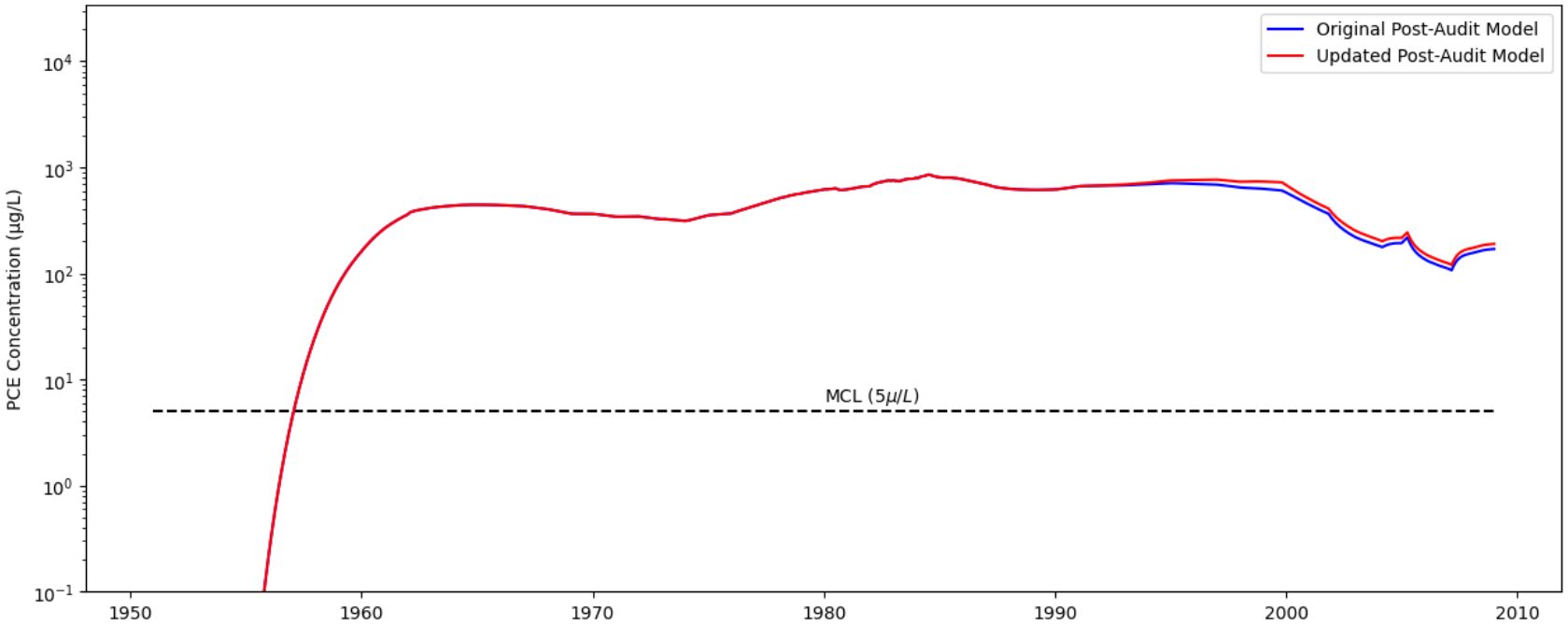


Decreasing Simulated Value



Notes:
All PCE results are shown in µg/L.
The upper panel shows ranked order plot using the updated post-audit results in order of decreasing observed value.
The lower panel shows ranked order plot using the updated post-audit results in order of decreasing simulated value.
PCE = tetrachloroethylene

Figure 7.
Rank Order Plots Using Updated Post-Audit Results
Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit



Note:
PCE = tetrachloroethylene

integral

Figure 8.
PCE Concentration in the Cell Containing Well TT-26 for Original Post-Audit Model and Updated Post-Audit Model
Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit

Tables

Table 1. Comparison of Simulated PCE Values with Original Truncated Precision and Corrected Full Precision

Date	Well	Simulated PCE Concentration (µg/L) Original Truncated Precision	Simulated PCE Concentration (µg/L) Corrected Full Precision	Difference
2/1/2000	C1	0	0.03	0.03
5/1/2002	C1	0	0.03	0.03
8/1/2002	C1	0	0.03	0.03
11/1/2002	C1	0	0.03	0.03
3/1/2003	C1	0	0.03	0.03
3/1/2004	C1	0	0.02	0.02
3/1/2005	C1	0	0.02	0.02
3/1/2006	C1	0	0.02	0.02
2/1/2007	C1	0	0.02	0.02
3/1/2008	C1	0	0.02	0.02
6/1/1997	C2	1095	1091.49	-3.26
2/1/2000	C2	742	738.91	-2.7
5/1/2002	C2	459	472.77	13.68
8/1/2002	C2	459	446.65	-12.44
11/1/2002	C2	424	422.03	-1.74
3/1/2003	C2	388	392.26	3.8
3/1/2004	C2	318	315.82	-2.01
3/1/2005	C2	247	260.53	13.32
3/1/2006	C2	212	211.45	-0.44
2/1/2007	C2	177	173.13	-3.44
3/1/2008	C2	141	142.83	1.57
6/1/1997	C3	388	406.01	17.55
2/1/2000	C3	388	391.14	2.68
5/1/2002	C3	283	279.11	-3.41
8/1/2002	C3	247	264.07	16.86
11/1/2002	C3	247	250.33	3.12
3/1/2003	C3	247	234.33	-12.88
3/1/2004	C3	212	197.19	-14.7
3/1/2005	C3	177	181.38	4.81
3/1/2006	C3	177	160.07	-16.51
2/1/2007	C3	141	137.45	-3.81
3/1/2008	C3	141	132.76	-8.5
6/1/1997	C4	0	1.96	1.96
2/1/2000	C4	0	2.32	2.32
1/1/2002	C4	0	1.89	1.89
5/1/2002	C4	0	1.84	1.84
8/1/2002	C4	0	1.81	1.81
11/1/2002	C4	0	1.78	1.78
3/1/2003	C4	0	1.74	1.74
3/1/2004	C4	0	1.64	1.64
3/1/2005	C4	0	1.61	1.61
3/1/2006	C4	0	1.53	1.53
2/1/2007	C4	0	1.46	1.46

Table 1. Comparison of Simulated PCE Values with Original Truncated Precision and Corrected Full Precision

Date	Well	Simulated PCE Concentration (µg/L) Original Truncated Precision	Simulated PCE Concentration (µg/L) Corrected Full Precision	Difference
3/1/2008	C4	0	1.37	1.37
6/1/1997	C5	1307	1322.54	15.9
2/1/2000	C5	1165	1180.29	14.9
5/1/2002	C5	989	997.52	8.71
8/1/2002	C5	989	973.25	-15.57
11/1/2002	C5	953	949.25	-4.24
3/1/2003	C5	918	918.45	0.26
3/1/2004	C5	812	827.28	15.04
3/1/2005	C5	777	759.89	-17.03
3/1/2006	C5	671	678.12	7.14
2/1/2007	C5	600	601.5	1.15
3/1/2008	C5	530	539.05	9.33
6/1/1997	C9	0	0.05	0.05
2/1/2000	C9	0	0.13	0.13
5/1/2002	C9	0	0.15	0.15
8/1/2002	C9	0	0.14	0.14
11/1/2002	C9	0	0.14	0.14
3/1/2003	C9	0	0.14	0.14
3/1/2004	C9	0	0.14	0.14
3/1/2005	C9	0	0.15	0.15
3/1/2006	C9	0	0.15	0.15
2/1/2007	C9	0	0.14	0.14
3/1/2008	C9	0	0.14	0.14
6/1/1997	C10	212	207.67	-4.22
2/1/2000	C10	177	177.67	1.09
5/1/2002	C10	71	67.3	-3.33
8/1/2002	C10	71	63.27	-7.36
11/1/2002	C10	71	59.53	-11.1
3/1/2003	C10	71	55.21	-15.42
3/1/2004	C10	35	45.75	10.43
3/1/2005	C10	35	37.75	2.44
3/1/2006	C10	35	36.41	1.1
2/1/2007	C10	35	33.52	-1.8
3/1/2008	C10	35	28.97	-6.34
1/1/2002	C12	177	189.34	12.76
5/1/2002	C12	177	187.07	10.5
8/1/2002	C12	177	185.57	9
11/1/2002	C12	177	184.18	7.61
3/1/2003	C12	177	182.75	6.18
3/1/2004	C12	177	180.99	4.41
3/1/2005	C12	177	180.51	3.94
3/1/2006	C12	177	176.92	0.34
2/1/2007	C12	177	167.45	-9.13

Table 1. Comparison of Simulated PCE Values with Original Truncated Precision and Corrected Full Precision

Date	Well	Simulated PCE Concentration (µg/L) Original Truncated Precision	Simulated PCE Concentration (µg/L) Corrected Full Precision	Difference
3/1/2008	C12	141	155.69	14.43
1/1/2002	C13	0	15.18	15.18
5/1/2002	C13	0	14.67	14.67
8/1/2002	C13	0	14.3	14.3
11/1/2002	C13	0	13.95	13.95
3/1/2003	C13	0	13.54	13.54
3/1/2004	C13	0	12.61	12.61
3/1/2005	C13	0	11.76	11.76
3/1/2006	C13	0	11.04	11.04
2/1/2007	C13	0	10.06	10.06
3/1/2008	C13	0	8.77	8.77
3/1/2005	C14	0	2.5	2.5
3/1/2006	C14	0	2.47	2.47
2/1/2007	C14	0	2.37	2.37
3/1/2008	C14	0	2.17	2.17
2/1/2007	C15-D	0	0	0
3/1/2008	C15-D	0	0	0
2/1/2007	C15-S	0	0.7	0.7
3/1/2008	C15-S	0	0.72	0.72
2/1/2007	C16	0	1.06	1.06
3/1/2008	C16	0	1.12	1.12
2/1/2007	C17-D	0	0.15	0.15
3/1/2008	C17-D	0	0.18	0.18
2/1/2007	C17-S	0	0.15	0.15
3/1/2008	C17-S	0	0.18	0.18
2/1/2007	C18	71	57.2	-13.43
3/1/2008	C18	71	57.85	-12.78
6/1/1997	FWC-11	848	840.1	-7.45
2/1/2000	FWC-11	812	814.04	1.8
1/1/2002	FWC-11	742	758.42	16.81
5/1/2002	FWC-11	742	744.37	2.77
8/1/2002	FWC-11	742	733.6	-8.01
11/1/2002	FWC-11	706	722.82	16.53
3/1/2003	FWC-11	706	708.92	2.62
3/1/2004	FWC-11	671	667.79	-3.19
3/1/2005	FWC-11	636	638.38	2.72
3/1/2006	FWC-11	600	598.3	-2.05
2/1/2007	FWC-11	565	552.3	-12.74
3/1/2008	FWC-11	494	510.69	16.28
6/1/1997	FWS-12	565	577.02	11.99
2/1/2000	FWS-12	530	540.71	10.99
1/1/2002	FWS-12	318	307.21	-10.62
5/1/2002	FWS-12	283	286.97	4.45

Table 1. Comparison of Simulated PCE Values with Original Truncated Precision and Corrected Full Precision

Date	Well	Simulated PCE Concentration (µg/L) Original Truncated Precision	Simulated PCE Concentration (µg/L) Corrected Full Precision	Difference
8/1/2002	FWS-12	283	270.99	-11.52
11/1/2002	FWS-12	247	255.68	8.48
3/1/2003	FWS-12	247	237.34	-9.87
3/1/2004	FWS-12	212	196.5	-15.39
3/1/2005	FWS-12	177	189.46	12.88
3/1/2006	FWS-12	177	161.56	-15.01
2/1/2007	FWS-12	106	110.59	4.65
3/1/2008	FWS-12	71	81.32	10.69
6/1/1997	FWS-13	1201	1188.33	-12.37
2/1/2000	FWS-13	1024	1040.89	16.77
1/1/2002	FWS-13	883	892.95	10.08
5/1/2002	FWS-13	848	852.77	5.22
8/1/2002	FWS-13	812	820.69	8.46
11/1/2002	FWS-13	777	787.96	11.04
3/1/2003	FWS-13	742	743.93	2.33
3/1/2004	FWS-13	600	609.43	9.08
3/1/2005	FWS-13	494	499.76	5.36
3/1/2006	FWS-13	388	394.47	6.01
2/1/2007	FWS-13	318	314.12	-3.71
3/1/2008	FWS-13	247	239.71	-7.49
5/1/2002	RWC-1	353	349.08	-4.06
8/1/2002	RWC-1	353	344.46	-8.68
11/1/2002	RWC-1	353	339.59	-13.55
3/1/2003	RWC-1	318	333.25	15.42
3/1/2004	RWC-1	318	315.77	-2.06
3/1/2005	RWC-1	318	302.14	-15.69
3/1/2006	RWC-1	283	285.52	3
2/1/2007	RWC-1	247	257.03	9.83
3/1/2008	RWC-1	247	234.51	-12.7
2/1/2000	RWC-2	106	120.26	14.32
1/1/2002	RWC-2	106	98.78	-7.17
5/1/2002	RWC-2	106	94.91	-11.03
8/1/2002	RWC-2	106	92.26	-13.68
11/1/2002	RWC-2	106	89.8	-16.14
3/1/2003	RWC-2	71	87.15	16.52
3/1/2004	RWC-2	71	81.63	11
3/1/2005	RWC-2	71	73.83	3.2
3/1/2006	RWC-2	71	72.89	2.26
2/1/2007	RWC-2	71	67.26	-3.37
3/1/2008	RWC-2	71	58.75	-11.88
5/1/2002	RWS-1A	247	252.3	5.1
8/1/2002	RWS-1A	247	230.07	-17.13
11/1/2002	RWS-1A	212	210.56	-1.33

Table 1. Comparison of Simulated PCE Values with Original Truncated Precision and Corrected Full Precision

Date	Well	Simulated PCE Concentration (µg/L) Original Truncated Precision	Simulated PCE Concentration (µg/L) Corrected Full Precision	Difference
3/1/2003	RWS-1A	177	187.77	11.2
3/1/2004	RWS-1A	141	135.71	-5.54
3/1/2005	RWS-1A	106	105.51	-0.44
3/1/2006	RWS-1A	71	87.15	16.52
2/1/2007	RWS-1A	71	74.44	3.81
3/1/2008	RWS-1A	35	44.53	9.21
5/1/2002	RWS-2A	424	410.56	-13.22
1/1/2002	RWS-2A	459	463.7	4.61
8/1/2002	RWS-2A	388	376.75	-11.71
11/1/2002	RWS-2A	353	347.03	-6.12
3/1/2003	RWS-2A	318	313.2	-4.64
3/1/2004	RWS-2A	247	234.28	-12.92
3/1/2005	RWS-2A	177	163.89	-12.68
3/1/2006	RWS-2A	141	153.47	12.21
2/1/2007	RWS-2A	141	126.41	-14.85
3/1/2008	RWS-2A	71	83.48	12.85
1/1/2002	RWS-3A	565	576.44	11.4
5/1/2002	RWS-3A	530	537.69	7.97
8/1/2002	RWS-3A	494	508.57	14.17
11/1/2002	RWS-3A	494	480.11	-14.29
3/1/2003	RWS-3A	459	445.13	-13.96
3/1/2004	RWS-3A	353	351.52	-1.63
3/1/2005	RWS-3A	283	273.41	-9.11
3/1/2006	RWS-3A	212	226.94	15.06
2/1/2007	RWS-3A	177	182.61	6.04
3/1/2008	RWS-3A	141	136.94	-4.32
1/1/2002	RWS-4A	388	376.18	-12.28
5/1/2002	RWS-4A	353	370.51	17.36
8/1/2002	RWS-4A	353	363.18	10.03
11/1/2002	RWS-4A	353	354.54	1.39
3/1/2003	RWS-4A	353	343.27	-9.88
3/1/2004	RWS-4A	318	307.24	-10.59
3/1/2005	RWS-4A	247	249	1.79
3/1/2006	RWS-4A	212	226.94	15.05
2/1/2007	RWS-4A	177	191.67	15.1
3/1/2008	RWS-4A	141	144.9	3.64
6/1/1997	S1	0	0.07	0.07
2/1/2000	S1	0	0.04	0.04
5/1/2002	S1	0	0.02	0.02
8/1/2002	S1	0	0.02	0.02
11/1/2002	S1	0	0.02	0.02
3/1/2003	S1	0	0.02	0.02
3/1/2004	S1	0	0.01	0.01

Table 1. Comparison of Simulated PCE Values with Original Truncated Precision and Corrected Full Precision

Date	Well	Simulated PCE Concentration (µg/L) Original Truncated Precision	Simulated PCE Concentration (µg/L) Corrected Full Precision	Difference
3/1/2005	S1	0	0.01	0.01
3/1/2006	S1	0	0.01	0.01
2/1/2007	S1	0	0.01	0.01
3/1/2008	S1	0	0	0
6/1/1997	S2	141	124.51	-16.75
2/1/2000	S2	71	61.79	-8.84
5/1/2002	S2	35	26.24	-9.08
8/1/2002	S2	35	23.48	-11.83
11/1/2002	S2	35	21.07	-14.25
3/1/2003	S2	35	18.38	-16.93
3/1/2004	S2	0	12.8	12.8
3/1/2005	S2	0	9.8	9.8
3/1/2006	S2	0	7.46	7.46
2/1/2007	S2	0	5.77	5.77
3/1/2008	S2	0	4.94	4.94
6/1/1997	S3	1024	1037.81	13.68
2/1/2000	S3	706	713.61	7.31
5/1/2002	S3	318	312.68	-5.15
8/1/2002	S3	283	275.86	-6.66
11/1/2002	S3	247	245.39	-1.82
3/1/2003	S3	212	212.9	1.01
3/1/2004	S3	141	149.53	8.27
3/1/2005	S3	106	118.13	12.18
3/1/2006	S3	106	91.02	-14.93
2/1/2007	S3	71	72.79	2.16
3/1/2008	S3	71	64.85	-5.77
6/1/1997	S4	106	102.11	-3.84
2/1/2000	S4	106	118.47	12.53
3/1/2004	S4	35	28.26	-7.05
3/1/2005	S4	35	22.1	-13.22
3/1/2006	S4	0	16.19	16.19
2/1/2007	S4	0	12.9	12.9
3/1/2008	S4	0	9.89	9.89
6/1/1997	S5	1624	1614.87	-9.61
2/1/2000	S5	989	974.99	-13.82
5/1/2002	S5	494	489.5	-4.9
8/1/2002	S5	459	448.69	-10.4
11/1/2002	S5	424	411.03	-12.75
3/1/2003	S5	353	365.41	12.27
3/1/2004	S5	247	250.4	3.19
3/1/2005	S5	177	182.23	5.65
3/1/2006	S5	141	128.28	-12.98
2/1/2007	S5	106	95	-10.94

Table 1. Comparison of Simulated PCE Values with Original Truncated Precision and Corrected Full Precision

Date	Well	Simulated PCE Concentration (µg/L) Original Truncated Precision	Simulated PCE Concentration (µg/L) Corrected Full Precision	Difference
3/1/2008	S5	71	70.59	-0.04
6/1/1997	S6	0	13.15	13.15
2/1/2000	S6	0	6.87	6.87
8/1/2002	S6	0	2.87	2.87
11/1/2002	S6	0	2.6	2.6
3/1/2003	S6	0	2.3	2.3
3/1/2004	S6	0	1.62	1.62
3/1/2005	S6	0	1.22	1.22
3/1/2006	S6	0	0.92	0.92
2/1/2007	S6	0	0.7	0.7
3/1/2008	S6	0	0.54	0.54
6/1/1997	S7	71	85.53	14.91
8/1/2002	S7	0	15.71	15.71
11/1/2002	S7	0	14.1	14.1
3/1/2003	S7	0	12.29	12.29
3/1/2004	S7	0	8.28	8.28
3/1/2005	S7	0	6.06	6.06
3/1/2006	S7	0	4.33	4.33
2/1/2007	S7	0	3.21	3.21
3/1/2008	S7	0	2.72	2.72
6/1/1997	S8	0	17.28	17.28
2/1/2000	S8	0	13.01	13.01
5/1/2002	S8	0	5.78	5.78
8/1/2002	S8	0	5.15	5.15
11/1/2002	S8	0	4.6	4.6
3/1/2003	S8	0	3.97	3.97
3/1/2004	S8	0	2.64	2.64
3/1/2005	S8	0	1.87	1.87
3/1/2006	S8	0	1.27	1.27
2/1/2007	S8	0	0.87	0.87
3/1/2008	S8	0	0.61	0.61
6/1/1997	S9	35	46.58	11.27
2/1/2000	S9	35	52.71	17.39
5/1/2002	S9	35	23.64	-11.67
8/1/2002	S9	35	20.85	-14.47
11/1/2002	S9	35	18.39	-16.92
3/1/2003	S9	0	15.66	15.66
3/1/2004	S9	0	9.92	9.92
3/1/2005	S9	0	7.29	7.29
3/1/2006	S9	0	4.7	4.7
2/1/2007	S9	0	2.96	2.96
3/1/2008	S9	0	2.04	2.04
6/1/1997	S10	494	505.03	10.62

Table 1. Comparison of Simulated PCE Values with Original Truncated Precision and Corrected Full Precision

Date	Well	Simulated PCE Concentration (µg/L) Original Truncated Precision	Simulated PCE Concentration (µg/L) Corrected Full Precision	Difference
2/1/2000	S10	494	501.67	7.27
1/1/2002	S10	494	481.5	-12.91
5/1/2002	S10	459	475.01	15.92
8/1/2002	S10	459	470.05	10.96
11/1/2002	S10	459	465.03	5.94
3/1/2003	S10	459	457.9	-1.19
3/1/2004	S10	424	435.43	11.65
3/1/2005	S10	424	414.73	-9.04
3/1/2006	S10	388	386.07	-2.39
2/1/2007	S10	353	356.43	3.28
3/1/2008	S10	318	325.82	7.99
6/1/1997	S11	0	0	0
2/1/2000	S11	0	0	0
3/1/2005	S14	0	10.36	10.36
3/1/2006	S14	0	8.5	8.5
2/1/2007	S14	0	6.89	6.89
3/1/2008	S14	0	5.29	5.29

Note:
PCE = tetrachloroethylene

Table 2. Simulated PCE Concentrations for Original and Updated Post-Audit Models

Date	Well	Simulated PCE Concentration (µg/L) Original	Simulated PCE Concentration (µg/L) Updated	Difference
2/1/2000	C1	0	0.04	0.04
5/1/2002	C1	0	0.03	0.03
8/1/2002	C1	0	0.03	0.03
11/1/2002	C1	0	0.03	0.03
3/1/2003	C1	0	0.03	0.03
3/1/2004	C1	0	0.03	0.03
3/1/2005	C1	0	0.03	0.03
3/1/2006	C1	0	0.02	0.02
2/1/2007	C1	0	0.02	0.02
3/1/2008	C1	0	0.02	0.02
6/1/1997	C2	1095	1316.4	221.64
2/1/2000	C2	742	900.8	159.19
5/1/2002	C2	459	580.6	121.51
8/1/2002	C2	459	548.86	89.77
11/1/2002	C2	424	518.92	95.15
3/1/2003	C2	388	482.65	94.19
3/1/2004	C2	318	389.28	71.45
3/1/2005	C2	247	321.59	74.38
3/1/2006	C2	212	261.33	49.44
2/1/2007	C2	177	214.18	37.61
3/1/2008	C2	141	176.88	35.63
6/1/1997	C3	388	434.52	46.06
2/1/2000	C3	388	439.84	51.37
5/1/2002	C3	283	307.28	24.76
8/1/2002	C3	247	290.84	43.64
11/1/2002	C3	247	275.9	28.7
3/1/2003	C3	247	258.55	11.35
3/1/2004	C3	212	218.29	6.41
3/1/2005	C3	177	201.45	24.87
3/1/2006	C3	177	177.93	1.36
2/1/2007	C3	141	153.16	11.9
3/1/2008	C3	141	148.59	7.33
6/1/1997	C4	0	1.96	1.96
2/1/2000	C4	0	2.32	2.32
1/1/2002	C4	0	1.9	1.9
5/1/2002	C4	0	1.85	1.85
8/1/2002	C4	0	1.81	1.81
11/1/2002	C4	0	1.78	1.78
3/1/2003	C4	0	1.74	1.74
3/1/2004	C4	0	1.64	1.64
3/1/2005	C4	0	1.62	1.62
3/1/2006	C4	0	1.54	1.54
2/1/2007	C4	0	1.47	1.47
3/1/2008	C4	0	1.38	1.38
6/1/1997	C5	1307	1326.87	20.22
2/1/2000	C5	1165	1190.26	24.87
5/1/2002	C5	989	1009.86	21.05
8/1/2002	C5	989	985.68	-3.13

Table 2. Simulated PCE Concentrations for Original and Updated Post-Audit Models

Date	Well	Simulated PCE Concentration (µg/L) Original	Simulated PCE Concentration (µg/L) Updated	Difference
11/1/2002	C5	953	961.76	8.27
3/1/2003	C5	918	931.03	12.85
3/1/2004	C5	812	839.91	27.67
3/1/2005	C5	777	772.91	-4.02
3/1/2006	C5	671	690.68	19.7
2/1/2007	C5	600	613.37	13.02
3/1/2008	C5	530	551.21	21.48
6/1/1997	C9	0	0.06	0.06
2/1/2000	C9	0	0.16	0.16
5/1/2002	C9	0	0.18	0.18
8/1/2002	C9	0	0.18	0.18
11/1/2002	C9	0	0.18	0.18
3/1/2003	C9	0	0.18	0.18
3/1/2004	C9	0	0.18	0.18
3/1/2005	C9	0	0.19	0.19
3/1/2006	C9	0	0.19	0.19
2/1/2007	C9	0	0.18	0.18
3/1/2008	C9	0	0.17	0.17
6/1/1997	C10	212	222.31	10.42
2/1/2000	C10	177	199.93	23.36
5/1/2002	C10	71	73.7	3.07
8/1/2002	C10	71	69.19	-1.44
11/1/2002	C10	71	65.02	-5.61
3/1/2003	C10	71	60.18	-10.45
3/1/2004	C10	35	49.48	14.17
3/1/2005	C10	35	40.32	5
3/1/2006	C10	35	38.86	3.54
2/1/2007	C10	35	35.65	0.33
3/1/2008	C10	35	30.46	-4.85
1/1/2002	C12	177	190.3	13.73
5/1/2002	C12	177	188.12	11.55
8/1/2002	C12	177	186.68	10.1
11/1/2002	C12	177	185.33	8.76
3/1/2003	C12	177	183.96	7.39
3/1/2004	C12	177	182.37	5.8
3/1/2005	C12	177	181.97	5.4
3/1/2006	C12	177	178.52	1.94
2/1/2007	C12	177	169.07	-7.51
3/1/2008	C12	141	157.22	15.96
1/1/2002	C13	0	15.21	15.21
5/1/2002	C13	0	14.7	14.7
8/1/2002	C13	0	14.34	14.34
11/1/2002	C13	0	13.98	13.98
3/1/2003	C13	0	13.57	13.57
3/1/2004	C13	0	12.66	12.66
3/1/2005	C13	0	11.81	11.81
3/1/2006	C13	0	11.1	11.1
2/1/2007	C13	0	10.12	10.12

Table 2. Simulated PCE Concentrations for Original and Updated Post-Audit Models

Date	Well	Simulated PCE Concentration (µg/L) Original	Simulated PCE Concentration (µg/L) Updated	Difference
3/1/2008	C13	0	8.83	8.83
3/1/2005	C14	0	2.5	2.5
3/1/2006	C14	0	2.48	2.48
2/1/2007	C14	0	2.37	2.37
3/1/2008	C14	0	2.17	2.17
2/1/2007	C15-D	0	0	0
3/1/2008	C15-D	0	0	0
2/1/2007	C15-S	0	0.7	0.7
3/1/2008	C15-S	0	0.72	0.72
2/1/2007	C16	0	1.06	1.06
3/1/2008	C16	0	1.12	1.12
2/1/2007	C17-D	0	0.15	0.15
3/1/2008	C17-D	0	0.18	0.18
2/1/2007	C17-S	0	0.15	0.15
3/1/2008	C17-S	0	0.18	0.18
2/1/2007	C18	71	57.22	-13.41
3/1/2008	C18	71	57.87	-12.76
6/1/1997	FWC-11	848	840.57	-6.98
2/1/2000	FWC-11	812	815.82	3.58
1/1/2002	FWC-11	742	760.83	19.22
5/1/2002	FWC-11	742	746.89	5.28
8/1/2002	FWC-11	742	736.19	-5.41
11/1/2002	FWC-11	706	725.49	19.19
3/1/2003	FWC-11	706	711.68	5.39
3/1/2004	FWC-11	671	670.83	-0.15
3/1/2005	FWC-11	636	641.83	6.16
3/1/2006	FWC-11	600	601.95	1.6
2/1/2007	FWC-11	565	556.03	-9.01
3/1/2008	FWC-11	494	514.79	20.38
6/1/1997	FWS-12	565	605.2	40.17
2/1/2000	FWS-12	530	607.3	77.58
1/1/2002	FWS-12	318	362.09	44.26
5/1/2002	FWS-12	283	340.91	58.4
8/1/2002	FWS-12	283	323.49	40.97
11/1/2002	FWS-12	247	306.42	59.22
3/1/2003	FWS-12	247	285.52	38.31
3/1/2004	FWS-12	212	236.65	24.76
3/1/2005	FWS-12	177	226.34	49.76
3/1/2006	FWS-12	177	194.09	17.52
2/1/2007	FWS-12	106	131.8	25.86
3/1/2008	FWS-12	71	94.64	24.01
6/1/1997	FWS-13	1201	1215.23	14.53
2/1/2000	FWS-13	1024	1107.38	83.25
1/1/2002	FWS-13	883	959.83	76.97
5/1/2002	FWS-13	848	917.47	69.92
8/1/2002	FWS-13	812	883.55	71.31
11/1/2002	FWS-13	777	848.85	71.92
3/1/2003	FWS-13	742	802.06	60.45

Table 2. Simulated PCE Concentrations for Original and Updated Post-Audit Models

Date	Well	Simulated PCE Concentration (µg/L) Original	Simulated PCE Concentration (µg/L) Updated	Difference
3/1/2004	FWS-13	600	658.46	58.11
3/1/2005	FWS-13	494	543.52	49.12
3/1/2006	FWS-13	388	429.96	41.5
2/1/2007	FWS-13	318	341.03	23.2
3/1/2008	FWS-13	247	259.6	12.4
5/1/2002	RWC-1	353	360.92	7.77
8/1/2002	RWC-1	353	356.8	3.65
11/1/2002	RWC-1	353	352.36	-0.79
3/1/2003	RWC-1	318	346.48	28.64
3/1/2004	RWC-1	318	329.75	11.92
3/1/2005	RWC-1	318	316.15	-1.69
3/1/2006	RWC-1	283	298.96	16.44
2/1/2007	RWC-1	247	270	22.8
3/1/2008	RWC-1	247	246.9	-0.3
2/1/2000	RWC-2	106	124.38	18.44
1/1/2002	RWC-2	106	102.55	-3.39
5/1/2002	RWC-2	106	98.4	-7.54
8/1/2002	RWC-2	106	95.58	-10.36
11/1/2002	RWC-2	106	92.98	-12.97
3/1/2003	RWC-2	71	90.16	19.53
3/1/2004	RWC-2	71	84.29	13.66
3/1/2005	RWC-2	71	76.21	5.58
3/1/2006	RWC-2	71	75.2	4.57
2/1/2007	RWC-2	71	69.28	-1.35
3/1/2008	RWC-2	71	60.39	-10.24
5/1/2002	RWS-1A	247	380.65	133.45
8/1/2002	RWS-1A	247	342.01	94.81
11/1/2002	RWS-1A	212	308.75	96.86
3/1/2003	RWS-1A	177	270.86	94.29
3/1/2004	RWS-1A	141	187.28	46.02
3/1/2005	RWS-1A	106	141.68	35.73
3/1/2006	RWS-1A	71	111.86	41.23
2/1/2007	RWS-1A	71	93.16	22.53
3/1/2008	RWS-1A	35	56.99	21.68
5/1/2002	RWS-2A	424	609.72	185.95
1/1/2002	RWS-2A	459	697.9	238.81
8/1/2002	RWS-2A	388	554.12	165.66
11/1/2002	RWS-2A	353	505.35	152.2
3/1/2003	RWS-2A	318	450	132.17
3/1/2004	RWS-2A	247	322.81	75.61
3/1/2005	RWS-2A	177	231.7	55.12
3/1/2006	RWS-2A	141	195.03	53.78
2/1/2007	RWS-2A	141	155.12	13.87
3/1/2008	RWS-2A	71	105.2	34.57
1/1/2002	RWS-3A	565	734.63	169.59
5/1/2002	RWS-3A	530	685.63	155.91
8/1/2002	RWS-3A	494	647.45	153.04
11/1/2002	RWS-3A	494	609.53	115.12

Table 2. Simulated PCE Concentrations for Original and Updated Post-Audit Models

Date	Well	Simulated PCE Concentration (µg/L) Original	Simulated PCE Concentration (µg/L) Updated	Difference
3/1/2003	RWS-3A	459	562.36	103.27
3/1/2004	RWS-3A	353	435.76	82.61
3/1/2005	RWS-3A	283	342.42	59.9
3/1/2006	RWS-3A	212	277.36	65.47
2/1/2007	RWS-3A	177	213.69	37.12
3/1/2008	RWS-3A	141	157.95	16.7
1/1/2002	RWS-4A	388	413.29	24.83
5/1/2002	RWS-4A	353	406.97	53.83
8/1/2002	RWS-4A	353	399.1	45.95
11/1/2002	RWS-4A	353	389.75	36.6
3/1/2003	RWS-4A	353	377.41	24.26
3/1/2004	RWS-4A	318	337.47	19.64
3/1/2005	RWS-4A	247	276.72	29.52
3/1/2006	RWS-4A	212	251.29	39.41
2/1/2007	RWS-4A	177	209.57	33
3/1/2008	RWS-4A	141	157.5	16.24
6/1/1997	S1	0	0.11	0.11
2/1/2000	S1	0	0.06	0.06
5/1/2002	S1	0	0.03	0.03
8/1/2002	S1	0	0.03	0.03
11/1/2002	S1	0	0.03	0.03
3/1/2003	S1	0	0.02	0.02
3/1/2004	S1	0	0.02	0.02
3/1/2005	S1	0	0.01	0.01
3/1/2006	S1	0	0.01	0.01
2/1/2007	S1	0	0.01	0.01
3/1/2008	S1	0	0.01	0.01
6/1/1997	S2	141	207.79	66.53
2/1/2000	S2	71	95.18	24.55
5/1/2002	S2	35	38.63	3.31
8/1/2002	S2	35	34.41	-0.9
11/1/2002	S2	35	30.73	-4.58
3/1/2003	S2	35	26.65	-8.67
3/1/2004	S2	0	18.16	18.16
3/1/2005	S2	0	13.62	13.62
3/1/2006	S2	0	10.18	10.18
2/1/2007	S2	0	7.79	7.79
3/1/2008	S2	0	6.57	6.57
6/1/1997	S3	1024	1321.69	297.57
2/1/2000	S3	706	1001.42	295.12
5/1/2002	S3	318	451.57	133.73
8/1/2002	S3	283	397.13	114.62
11/1/2002	S3	247	352.03	104.83
3/1/2003	S3	212	303.81	91.92
3/1/2004	S3	141	207.92	66.66
3/1/2005	S3	106	167.82	61.88
3/1/2006	S3	106	119.56	13.62
2/1/2007	S3	71	91.67	21.04

Table 2. Simulated PCE Concentrations for Original and Updated Post-Audit Models

Date	Well	Simulated PCE Concentration (µg/L) Original	Simulated PCE Concentration (µg/L) Updated	Difference
3/1/2008	S3	71	82.39	11.76
6/1/1997	S4	106	102.72	-3.23
2/1/2000	S4	106	121.75	15.8
3/1/2004	S4	35	29.29	-6.02
3/1/2005	S4	35	22.94	-12.38
3/1/2006	S4	0	16.81	16.81
2/1/2007	S4	0	13.37	13.37
3/1/2008	S4	0	10.24	10.24
6/1/1997	S5	1624	1773.95	149.47
2/1/2000	S5	989	1136.51	147.7
5/1/2002	S5	494	584.04	89.63
8/1/2002	S5	459	534.73	75.64
11/1/2002	S5	424	489.23	65.46
3/1/2003	S5	353	434.22	81.08
3/1/2004	S5	247	295.95	48.74
3/1/2005	S5	177	216.07	39.5
3/1/2006	S5	141	150.33	9.08
2/1/2007	S5	106	109.32	3.37
3/1/2008	S5	71	80.8	10.17
6/1/1997	S6	0	21.11	21.11
2/1/2000	S6	0	10.5	10.5
8/1/2002	S6	0	4.26	4.26
11/1/2002	S6	0	3.85	3.85
3/1/2003	S6	0	3.38	3.38
3/1/2004	S6	0	2.35	2.35
3/1/2005	S6	0	1.73	1.73
3/1/2006	S6	0	1.28	1.28
2/1/2007	S6	0	0.97	0.97
3/1/2008	S6	0	0.74	0.74
6/1/1997	S7	71	134.14	63.51
8/1/2002	S7	0	23.27	23.27
11/1/2002	S7	0	20.84	20.84
3/1/2003	S7	0	18.07	18.07
3/1/2004	S7	0	11.97	11.97
3/1/2005	S7	0	8.59	8.59
3/1/2006	S7	0	6.02	6.02
2/1/2007	S7	0	4.38	4.38
3/1/2008	S7	0	3.64	3.64
6/1/1997	S8	0	27.91	27.91
2/1/2000	S8	0	22.16	22.16
5/1/2002	S8	0	9.98	9.98
8/1/2002	S8	0	8.89	8.89
11/1/2002	S8	0	7.93	7.93
3/1/2003	S8	0	6.85	6.85
3/1/2004	S8	0	4.54	4.54
3/1/2005	S8	0	3.2	3.2
3/1/2006	S8	0	2.16	2.16
2/1/2007	S8	0	1.46	1.46

Table 2. Simulated PCE Concentrations for Original and Updated Post-Audit Models

Date	Well	Simulated PCE Concentration (µg/L) Original	Simulated PCE Concentration (µg/L) Updated	Difference
3/1/2008	S8	0	1.01	1.01
6/1/1997	S9	35	57.92	22.6
2/1/2000	S9	35	73.25	37.93
5/1/2002	S9	35	35.02	-0.29
8/1/2002	S9	35	31.03	-4.29
11/1/2002	S9	35	27.5	-7.82
3/1/2003	S9	0	23.55	23.55
3/1/2004	S9	0	15.17	15.17
3/1/2005	S9	0	11.39	11.39
3/1/2006	S9	0	7.41	7.41
2/1/2007	S9	0	4.68	4.68
3/1/2008	S9	0	3.25	3.25
6/1/1997	S10	494	505.27	10.86
2/1/2000	S10	494	503.55	9.15
1/1/2002	S10	494	484.38	-10.02
5/1/2002	S10	459	477.98	18.89
8/1/2002	S10	459	473.09	14
11/1/2002	S10	459	468.13	9.03
3/1/2003	S10	459	461.09	2
3/1/2004	S10	424	438.9	15.12
3/1/2005	S10	424	418.76	-5.02
3/1/2006	S10	388	390.31	1.85
2/1/2007	S10	353	360.66	7.51
3/1/2008	S10	318	330.09	12.26
6/1/1997	S11	0	0	0
2/1/2000	S11	0	0	0
3/1/2005	S14	0	10.43	10.43
3/1/2006	S14	0	8.57	8.57
2/1/2007	S14	0	6.94	6.94
3/1/2008	S14	0	5.34	5.34

Note:
PCE = tetrachloroethylene

Exhibit 1

Resume for R. Jeffrey Davis

Education & Credentials

M.S., Civil & Environmental Engineering, Brigham Young University, Provo, Utah, 1998

B.S., Civil & Environmental Engineering, Brigham Young University, Provo, Utah, 1993

Professional Engineer, Utah (License No. 189690-2202), Texas (License No. 125406), Florida (License No. 74838), Colorado (License No. 0051575), Alabama (License No. PE52096), Idaho (License No. P-21839), Oregon (License No. 104270PE)

Certified Groundwater Professional, NGWA (2023)

Certified Water Rights Examiner, Oregon (License No. 104270)

Continuing Education

Certificate of Specialization in Leadership and Management, Harvard Business School Online (2023)

MSHA certified (2020)

First Aid and CPR certified (2020)

Professional Affiliations

National Ground Water Association

R. Jeffrey Davis, P.E., CGWP, CWRE

Principal, Water Resources

(385) 955-5184

Salt Lake City, UT

jdavis@integral-corp.com

Mr. Jeff Davis is a licensed civil and environmental engineer, hydrogeologist, and certified groundwater professional with almost 30 years of global experience working on every continent except Antarctica. He currently serves on the Board of Directors for the National Ground Water Association. Mr. Davis has supported numerous litigation cases involving groundwater impacts and has experience as an expert witness. He has spent much of his career solving complicated water problems involving mining, oil and gas, and water resources. These projects include the clean water supply side as well as the remediation of contaminated sites. The contaminated sites include coal combustion residual (CCR) landfills and other waste impoundments, mining remediation sites, and industrial cleanup sites—both RCRA and CERCLA sites. In working with per- and polyfluoroalkyl substance (PFAS) compounds, MTBE, chlorinated solvents, hydrocarbons, nitrates, and road salt, he has developed and used numerous groundwater models for the mining, energy, chemical, and agricultural industries. Other projects have involved environmental impact statements, environmental assessments, sea level rise and groundwater intrusion, water management, groundwater–surface water contamination, dewatering, natural resource damage assessment, and water supply and treatment. He has extensive knowledge of groundwater flow-and-transport principles and has taught numerous workshops and classes in the U.S. and around the world. His current focus is on water and groundwater sustainability and drought resiliency. Mr. Davis has extensive experience in the design and implementation of aquifer storage and recovery (ASR) projects across the country.

Relevant Experience

WATER MANAGEMENT

Water Supply and ASR Feasibility, Sacramento County, California — Served as principal investigator for a proposed land development project that evaluated the feasibility of developing a reliable water supply and implementing an ASR program. Key tasks included constructing a conceptual hydrogeologic model and conducting a geophysical survey to characterize the subsurface. The study provided critical insights into sustainable water management options to support the development while ensuring long-term resource stability.

Water Rights and Supply Analysis, Umatilla County, Oregon — Served as principal investigator for a project that involved a water rights and water supply study for an industrial client in eastern Oregon. The client was facing curtailment of groundwater withdrawals by the Oregon Water

Professional Affiliations (con't.)

Utah Groundwater Association

Groundwater Resources Association of California

Resources Department. The department alleged that the client's pumping was impacting nearby stream flows, prompting a detailed analysis of hydrogeologic data and monitoring records. The study demonstrated minimal to no connection between the groundwater pumping and river flows, providing critical evidence to support the client's continued water use.

ASR Feasibility, Ada County, Idaho — Served as principal investigator for a feasibility study for an ASR project. Ada County owns and operates Hubbard Reservoir, which receives irrigation water from the New York Canal. The project included building a conceptual model of the site and refining an existing groundwater model to analyze the effects of recharge from the reservoir.

ASR Feasibility and Piloting, Utah County, Utah — Served as principal investigator for a feasibility study for an ASR project. During the spring runoff of 2023, the team measured the runoff in several rivers, creeks, and ditches, and constructed a new infiltration basin, all in an effort to advance aquifer storage projects within the county. The project has continued with permitting and the implementation of a pilot project for the constructed infiltration basin.

ASR Feasibility, Utah County, Utah — Served as principal for a feasibility study for an ASR project. Former agricultural water rights were converted for industrial use and the effluent was being considered for aquifer replenishment. Both infiltration and direct injection of the treated water were considered as part of the feasibility study.

Provo ASR, Provo, Utah — Served as the project manager and engineer of record for the current Provo ASR project. Five sites (three infiltration and two direct injection) are currently permitted for pilot studies that have been ongoing since 2020. Final engineering design and permitting have been completed for all five sites.

Water Reuse and Aquifer Sustainability, Eagle Mountain, Utah — Served as the client manager and engineer of record for the current Eagle Mountain City, Utah, water-reuse planning and aquifer sustainability project. Water rights for Eagle Mountain were evaluated along with the groundwater system to understand aquifer sustainability for the city, which is expecting tremendous future growth, including large industrial water demands.

ASR Evaluation, Weber County, Utah — Served as the project manager and engineer of record for the current evaluation of the Weber Basin Water Conservancy District, Utah, ASR project. This project has been actively operating for more than 10 years. Hired to evaluate the storage capacity of the program and obtain greater recovery volumes from the system, working with the Utah Division of Water Rights.

Drainage Reuse Initiative, Harris County, Texas — Served as part of a team for the development of the Drainage Reuse Initiative for Harris County Flood Control District in Harris County, Texas. The project investigated the feasibility of alternative methods of flood mitigation by conveying stormwater to the subsurface, including natural infiltration to groundwater, enhanced infiltration or injection into aquifers, and mechanical injection to deep aquifers.

Roseville ASR, Roseville, California — Served as one of the groundwater leads for the development of an ASR program for the city of Roseville, California. Initial efforts involved developing a regional- scale conceptualization for the major portion of the Central Valley area.

Developed a subsequent regional multilayer groundwater model, followed by a number of local-scale transport models to simulate pilot tests and understand the ASR process.

COAL COMBUSTION FACILITIES

Coal Combustion Residual Waste and Disposal, Bonanza, Utah — Served as the engineer of record for a coal power plant. Oversaw all efforts related to the monitoring and compliance of the facility's CCR waste and disposal. This included semiannual reporting, development of alternative source demonstrations, and annual groundwater monitoring reports.

Hexavalent Chromium Investigation, United States — Served as the principal investigator for a study to understand and evaluate the proposed EPA changes to hexavalent chromium (Cr(VI)) as it would apply to the monitoring and management of CCR landfill facilities. The work included examining potential regulatory levels from a human health perspective.

Alternate Water Sources Investigation, United States — Served as the principal investigator for a study to understand and evaluate differences at CCR facilities between upgradient and downgradient sources, and locate potential evidence of alternate sources using isotopes and microbial fingerprinting. After development of a sampling and analysis plan, advanced statistical and multivariate methods were used to document analyses that show potential for distinguishing source water from alternate sources.

OIL AND GAS WASTE MANAGEMENT

Oil and Gas Waste Facility, De Beque, Colorado — Served as the principal engineer for the permitting and operating of an 800-acre oil-and-gas waste-disposal facility southeast of De Beque, Colorado. Involved in several aspects of the permitting process, including the hydrogeological study and groundwater investigations; stormwater design; pond liner design and construction; closure certification; and submittal of the revised engineering design and operation plan.

Remedial Investigation, Billings, Montana — Served as the groundwater lead for the Yale Oil of South Dakota Facility in Billings, Montana. The Superfund site facility is in the remedial investigation phase; the risk-assessment work plan has been submitted to the Montana Department of Environmental Quality, and the client is waiting for comments before proceeding with the risk assessment.

EPA Study, Washington, DC — Served as participant and technical reviewer for EPA's "Study of Hydraulic Fracturing for Oil and Gas and Its Potential Impact on Drinking Water Resources." Participated in technical roundtables and technical workshops and completed a peer review of the EPA's five retrospective case studies.

Fate and Transport Modeling, Texas — Served as groundwater lead for fate-and-transport modeling and analysis of chloride contamination in southern Texas near the Gulf of Mexico. As part of the site mitigation phase, modeling was used to determine the potential migration of the chloride through the shallow aquifer system and nearby receptors.

Lockwood Solvent Groundwater Plume Site, Billings, Montana — Served as one of the groundwater leads performing groundwater modeling for the Lockwood Solvent Groundwater

Plume site, an EPA Superfund site in Billings, Montana. The site spans 580 acres, and much of the groundwater there is contaminated with volatile organic compounds, including tetrachloroethene, trichloroethene, *cis*-1,2- dichloroethene, and vinyl chloride.

PLANNING AND PERMITTING

Beverage Can Manufacturing and Filling, Salt Lake City, Utah — Served as principal investigator for wastewater, stormwater, and Utah Pollutant Discharge Elimination System permitting, monitoring, and compliance for an aluminum can manufacturing and filling facility. Worked closely with the client, its operations team, and state and municipal regulators to regularly monitor and report all discharges from the facility.

Ely Energy Center EIS, White Pine County, Nevada — Served as principal lead for the development of a regional groundwater model for Steptoe Valley in White Pine County, Nevada. The investigation and model were part of the EIS for construction of the Ely Energy Center.

Haile Gold Mine EIS, Kershaw, South Carolina — Served as groundwater lead as the third-party contractor developing an EIS for the proposed Haile Gold Mine near Kershaw, South Carolina. The EIS analyzed the potential direct, indirect, and cumulative environmental effects of the proposed project and its alternatives. Work included project-team coordination for geology, groundwater, and surface water resources areas; review of applicant-supplied information; agency coordination; and public involvement.

Four Corners Power Plant EIS, Farmington, New Mexico — Served as groundwater lead as the third- party contractor in developing an EIS for the Four Corners Power Plant and Navajo coal mine in Farmington, New Mexico. The EIS analyzed the potential direct, indirect, and cumulative environmental effects of the proposed project and its alternatives. The groundwater portion included analyzing field investigations, pump tests, conceptual and numerical modeling of the project and surrounding area, and remediation and reclamation activities.

Iron Ore Operations Cumulative Impact Assessment, Pilbara, Western Australia — Served as one of the groundwater leads for a cumulative impact assessment for a proposed expansion of iron ore operations in the Pilbara in Western Australia. Work included identifying the methodology and developing the conceptual models to perform the assessment. The groundwater modeling included both quantitative and qualitative approaches.

LITIGATION SUPPORT

Road Salt Contamination Litigation, Boise County, Idaho — Served as the principal lead to support litigation related to road salt contamination of a drinking water aquifer serving private wells in Lowman, Idaho. The contamination was traced to negligent storage practices by the Idaho Department of Transportation, with a conceptual model developed to demonstrate the source and migration of the salt into the aquifer. Provided recommendations to mitigate the contamination, restore groundwater quality, and prevent future impacts to the community's drinking water supply.

PCE Contamination Litigation, Onslow County, North Carolina — Served as a testifying expert for a project involving PCE-contaminated groundwater impacting a public water supply. Performed a post-audit of an existing groundwater fate and transport model to assess its

accuracy and reliability and extended the model's time domain to evaluate its performance against updated concentration data from multiple monitoring wells.

ASR Well Design and Construction Litigation, Washington County, Oregon — Served as a testifying expert in a litigation case involving allegations of design and construction failures in an ASR well. The client, accused of lacking standard of care in its engineering services, required a technical review of the well design, construction practices, and operational performance. The analysis provided an expert evaluation of the ASR well' deficiencies and clarified the extent of liability and adherence to professional standards.

Stormwater Pipeline Litigation, Sweetwater County, Wyoming — Served as the engineering expert for a litigation case involving the failure of a stormwater pipeline at a trona ore mining and processing facility, where the client, a construction company, faced accusations of negligence. The work included multiple site visits to assess pipeline conditions and a detailed review of engineering plans to evaluate construction practices and compliance with design specifications. The findings provided critical insights into potential causes of failure and helped clarify the client's responsibilities under standard construction practices.

Expert Witness for PFAS Litigation, Martin County, Florida — Served as the groundwater expert witness for a litigation case in Martin County. The multidistrict litigation bellwether case involved PFAS contamination of groundwater affecting public drinking water. Opinions were given regarding PFAS sourcing, and fate and transport in groundwater, and regarding public water supply planning.

Water Resources Litigation, Grand County, Colorado — Served as principal investigator for a litigation case involving flooding damages caused by a canal breach. Surface water modeling was used to determine amount and extent of erosion and sedimentation from the flooding.

Water Resources Litigation, Northwest Minnesota — Served as principal investigator and expert witness for a litigation case involving agricultural water rights and pumping near tribal lands. Developed a conceptual model to understand the hydrogeological conditions and constructed a groundwater model to determine possible impacts due to the agriculture activities.

Groundwater Litigation, Ventura County, California — Served as the groundwater expert for a litigation case in Ventura County. The case includes the development of a basin-wide groundwater- surface water model, not only for purposes of litigation but also for compliance with Sustainable Groundwater Management Act requirements. The groundwater basin in question is currently listed as a priority basin by the State of California.

Pipeline Spill Litigation, Williston, North Dakota — Provided litigation services for groundwater and surface water contamination from a pipeline spill in North Dakota. A large spill of produced water (brine) impacted surface streams as well as the shallow aquifer system. Work included groundwater modeling, field investigations, and remedial strategies.

Road Salt Contamination Litigation, Vandalia, Ohio — Performed fate-and-transport modeling and analysis of sodium chloride contamination of an aquifer in Vandalia, Ohio. Stored road salt caused limited contamination of a shallow aquifer that supplied drinking water to nearby residential homes. The groundwater model included the local domestic pumping wells, which

helped determine the possible extent of chloride impacts. Largely due to the conceptual site model and transport modeling results, litigation was settled out of court to the satisfaction of the client.

CLIMATE IMPACT ASSESSMENT

Sea Level Rise Groundwater Intrusion Modeling, Alameda County, California — Served as the principal groundwater lead and engineer for a project that supported a climate adaptation initiative for the Port of Oakland addressing the impacts of sea level rise on subsurface conditions. The work involved detailed subsurface characterization and groundwater intrusion modeling to assess the potential for rising seawater to affect infrastructure and operations. The analysis provided critical data to inform resilience strategies and adaptation measures for long-term sustainability.

Sea Level Rise Groundwater Intrusion Monitoring, Ventura County, California — Served as the principal groundwater lead and engineer for a project that supported a climate adaptation program for the naval facility at Point Mugu by evaluating groundwater intrusion risks associated with sea level rise. Analyzed groundwater monitoring data to identify trends and data gaps critical for assessing potential impacts on infrastructure and operations as well as habitat. The results informed targeted monitoring and adaptation strategies to enhance the facility's resilience to future climate-related challenges.

Sea Level Rise Groundwater Intrusion Assessment, Santa Barbara County, California — Served as the principal groundwater lead and engineer for a proposed coastal hotel expansion in Santa Barbara County. The project involved reviewing technical studies to assess potential environmental and resource challenges. Critically evaluated key reports, including a sea level rise hazard study, water resource reports, and stormwater and drainage studies, to identify gaps and raise concerns about the feasibility and sustainability of the development. The analysis provided valuable insights to guide decision-making and ensure compliance with long-term coastal resilience and resource management goals.

GROUNDWATER MODELING

Subsidence Monitoring/Modeling, Fort Bend and Harris Counties, Texas — Served as the groundwater lead and engineer on several groundwater development projects in Fort Bend and Harris counties. Groundwater withdrawals are strictly curtailed due to historical subsidence. The Subsidence Districts have installed GPS Port-A-Measure (PAM) units and used InSAR mapping. Using this data plus the output from the models PRESS and MODFLOW-SUB to measure subsidence impacts.

Groundwater Model Development, New Jersey — Led a team of hydrogeologists to construct a groundwater flow and fate and transport model of perfluorononanoic acid and other contaminants. The model will be used to design a pump and treat system and possible aquifer replenishment with the treated groundwater.

Hydrogeological Services, Montgomery County, Texas — Provided modeling and hydrogeological consulting services for the Lone Star Ground-water Conservation District's (Montgomery County, Texas) update of its desired future conditions and groundwater management plans. Also provided litigation services for the district.

Groundwater Model Development, Havana, Florida — Provided consulting services for Northwest Florida Water Management District as it updated its regional groundwater model—an integrated groundwater-surface water model that provides regulatory control of the groundwater withdrawals and manages saltwater intrusion in the Floridan aquifer due to pumping.

Crop Production Services, Various Locations, U.S. — Served as the groundwater lead to provide modeling and hydrogeological consulting services for a number of crop production services legacy sites. The groundwater at the sites was contaminated with nitrates from long-term fertilizer use. Groundwater modeling was used to determine the fate and transport of the nitrates and to develop a remedial strategy for cleanup.

Legacy Way Tunnel Design, Brisbane, Australia — Provided senior oversight and technical review for all hydrogeologic assessments related to the Legacy Way tunnel design project, a 4.6 km underground tunnel in northern Brisbane, Australia. Work included evaluating field tests, preparing geotechnical and environmental reports, and modeling the entire project area.

Mercury Fate and Transport, Cincinnati, Ohio — Served as the groundwater lead for performing fate and-transport modeling and analysis of a mercury spill at a municipal landfill in Cincinnati, Ohio. As part of the project management phase, modeling was used to determine the potential migration of mercury through the landfill to the leachate collection system. Modeling efforts examined both the spatial distribution and the temporal component of the mercury transport.

Due Diligence Environmental Review, Pascagoula, Mississippi — Served as the environmental lead for performing an environmental assessment at a chemical plant in Pascagoula, Mississippi, as part of a due diligence effort. A number of groundwater and surface water contamination issues due to spills, leaks, and storage of hazardous materials were addressed. The location of the plant on the Gulf of Mexico makes possible environmental impacts from operation of the chemical plant a sensitive issue.

MINING

Bingham Canyon Mine Closure Planning, Copperton, Utah — Completed an independent third-party audit for a closure-plan pit-lake study for Bingham Canyon Mine. Reviewed the consultant scope of work for the pit-lake study and discussed the study, methodology, and pathway to completion with consultant staff. An independent audit report was compiled and submitted to the client.

Hooker Prairie Mine, Bartow, Florida — Served as the model expert to develop a contaminant and water budget and management model for the Hookers Prairie Mine in Florida using the GoldSim modeling software. The purpose of the model was to evaluate the probabilities of the mine meeting its current and future nutrient NPDES loading limits for certain contaminants. The project also included an evaluation of current monitoring data within the mine operations and at discharge locations, and the development of a complete monitoring plan integrated into a GIS as part of the model calibration and validation.

Bridger Coal Mine Investigation, Rock Springs, Wyoming — Served on a technical team to reevaluate groundwater conditions, and treatment and discharge alternatives at the Bridger coal

mine in southwest Wyoming. Previous studies' predicted maximum flows into the mine had been exceeded. Reassessed the situation and provided solutions.

EMERGENCY RESPONSE

Emergency Response to Battery Fire, New York — Served as the principal in charge leading a team of multidisciplinary scientists, engineers, toxicologists, and risk assessors for an environmental emergency response at a large-scale battery power storage unit at a solar farm. A thermal incident where several cargo container boxes caught fire and burned required immediate action to assess the environmental and human health impacts.

Emergency Response to Battery Fire, California — Served as the principal in charge leading a team of multidisciplinary scientists, engineers, toxicologists, and risk assessors for an environmental emergency response at a large-scale battery power storage facility. A thermal incident where several cargo container boxes caught fire and burned required immediate action to assess the environmental and human health impacts.

ECOLOGICAL RESTORATION

Ecological Restoration, Northeast Idaho — Serves as the principal in charge leading a team of scientists, engineers, and ecologists for an ecological restoration effort in northeast Idaho. The project has involved restoring flow to a creek and working with a number of state and federal agencies to develop and implement a conceptual restoration plan and a mitigation and monitoring plan. The project will also include obtaining the necessary permits and overseeing the restoration in an area of critical habitat.

PROJECT MANAGEMENT

GMS Software Development, Utah — Served as chief engineer for the original development of the software Groundwater Modeling System (GMS) at the Environmental Modeling Research Laboratory at Brigham Young University. A sophisticated graphical environment for groundwater model pre- and post-processing, 3-dimensional site characterization, and geostatistics, GMS is the official groundwater application of the U.S. Department of Defense and is also used by the U.S. Department of Energy, EPA, and thousands of users across the world.

NATURAL RESOURCE DAMAGE ASSESSMENT

Natural Resource Damage Assessment, Southeastern Idaho — Served as the groundwater expert determining groundwater damages in southeastern Idaho due to decades of phosphate mining. Led a team of hydrogeologists evaluating the impacts of selenium and other contaminants and changes in natural groundwater flows across the entire region. The damage assessment included a number of mining areas as well as the facilities where the phosphate material was processed.

Natural Resource Damage Assessment, Eastern Washington — Served as the groundwater expert determining groundwater damages in eastern Washington due to decades of groundwater contamination. For future development on the site, an ASR program is being considered as part of the restoration and long-term sustainability of the groundwater resources.

Presentations / Posters

Davis, R.J. 2024. Assessing a social value of water in aquifer storage and recovery projects. National Ground Water Association Groundwater Week. December 9–12. Las Vegas, NV.

Davis, R.J. 2024. Assessing a social value of water in aquifer storage and recovery projects. Salt Lake County Watershed Symposium. November 20–21. Salt Lake City, UT.

Davis, R.J. 2024. Great Salt Lake of Utah: Watershed, legislative, and community issues surrounding it. Environmental Professional Industry Charities (EPIC). October 24. Salt Lake City, UT.

Davis, R.J. 2024. Assessing a social value of water in ASR projects. Groundwater Resources Association of California Western Groundwater Congress. October 7–9. Lake Tahoe, NV.

Davis, R.J. 2024. Assessing a social value of water in ASR projects. The Geological Society of America: Connects 2024. September 22–25. Anaheim, CA.

Davis, R.J. 2024. Water in Utah: Continuing to navigate the present and shaping our future water demands. American Groundwater Trust. August 6–7. Salt Lake City, UT.

Davis, R.J. 2024. Assessing a social value of water in ASR projects. Biennial Symposium on Managed Aquifer Recharge. April 4–5. Tucson, AZ.

Davis, R.J. 2023. Challenges limiting managed aquifer recharge (MAR) adoption in the West. National Ground Water Association Groundwater Summit. December 5–7. Las Vegas, NV.

Davis, R.J. 2023. Water, AI, and us: What does the future hold for solving Utah's water challenges. Hint: It can't be solved without you and me. Salt Lake County Watershed Symposium. November 15–16. Salt Lake City, UT.

Davis, R.J. 2023. Building climate resilience through sustainable remediation in the western region. Groundwater Resources Association of California Western Groundwater Congress. September 12–14. Burbank, CA.

Davis, R.J. 2023. Water in Utah: Navigating the present and shaping the future. American Groundwater Trust. August 14–15. Provo, Utah.

Davis, R.J. 2023. More managed aquifer recharge and saving the Great Salt Lake—A balancing act. Idaho Water Users Association. June 12–13. Sun Valley, ID.

Davis, R.J. 2023. More managed aquifer recharge: Deliberate resiliency to combat droughts and climate change in the West. Association for Environmental Health of Soils. March 20–23. San Diego, CA.

Davis, R.J. 2023. Resilient and sustainable remediation. ESG|Climate Resilient & Sustainable Remediation Symposium. Groundwater Resources Association of California Western Groundwater Congress. February 6–7. San Diego, CA.

Davis, R.J. 2022. More managed aquifer recharge: Solutions to combat droughts and climate change in the West. National Ground Water Association Groundwater Summit. December 6–8. Las Vegas, NV.

Davis, R.J. 2022. Saving our aquifers: Climate change and managed aquifer recharge. Salt Lake County Watershed Symposium. November 16–17. Salt Lake City, UT.

Davis, R.J. 2022. More managed aquifer recharge—A solution to combat droughts and climate change in the West. Groundwater Resources Association of California Western Groundwater Congress. September 21–23. Sacramento, CA.

Davis, R.J. 2022. Saving our aquifers—Climate change, sustainability, and managed aquifer recharge. International Water Holdings. August 24–25. Salt Lake City, UT.

Davis, R.J. 2022. More managed aquifer recharge (MMAR) a solution to combat droughts and climate change in the West. Groundwater Protection Council Annual Forum. June 21–23. Salt Lake City, UT.

Davis, R.J. 2022. Aquifer storage and recovery—Hydrogeologic considerations. American Water Resources Association. May 17. Salt Lake City, UT.

Davis, R.J. 2022. Utah hydrology—What you do and don't know about Utah hydrogeology. National Ground Water Association. May 4, 2022. Virtual.

Davis, R.J. and B. Lemon. 2022. Provo, Utah: From planning to pilot to a final aquifer storage and recovery (ASR) program. Utah Water Users Workshop. March 21–23. St. George, UT.

Davis, R.J. 2021. Provo, Utah, from planning to pilot to a final managed aquifer recharge (MAR) program. National Ground Water Association Groundwater Summit. December 7–8. Virtual.

Davis, R.J. 2021. Provo City aquifer storage and recovery project. Ground Water Protection Council Annual Forum, September 27–29. Virtual.

Davis, R.J. 2021. Provo, Utah, from planning to pilot to a final managed aquifer recharge (MAR) program. American Public Works Association Utah Section Annual Conference. September 21–22. Sandy, UT.

Davis, R.J. 2021. Provo City aquifer storage and recovery project. Utah Water Users Workshop. May 17–19. St. George, UT.

Davis, R.J. 2021. Provo, Utah: From planning to pilot to a final managed aquifer recharge (MAR) program. ASR for Texas, Virtual Webinar. May 4–5.

Davis, R.J. 2021. Provo aquifer storage and recovery—From planning to pilot. American Water Works Association Virtual Summit on Sustainable Water, PFAS, Waterborne Pathogens. February 10–11.

Davis, R.J. 2020. Update on Provo's aquifer storage and recovery program. American Water Works Association Virtual Intermountain Section Annual Conference. October 21–23. Sun Valley, ID.

Davis, R.J. 2020. Are you prepared for the new federal permit process for CCR facilities? Second Annual Coal Ash and Combustion Residual Management Webinar, October 7–8. Virtual.

Invited Participant, Expert Panels, and Workshops

Avoiding the Pitfalls in Engaging Expert Consultants, Holland & Hart, March 18, 2024, Salt Lake City, UT.

Managed Aquifer Recharge Guidance, Interstate Technology & Regulatory Council, Managed Aquifer Recharge Team. December 2023.

Bulk Water Innovation Partnership (BWIP): More managed aquifer recharge: Deliberate resiliency to combat droughts and climate change in the West. December 6, 2023. Virtual.

Rocky Mountain Association of Environmental Professionals (RMAEP): Great Salt Lake of Utah: watershed, legislative, and community issues surrounding it. September 20, 2023.

Salt Lake Chamber: Utah Water Outlook. April 13, 2022.

EDCUtah Webinar: Water: Constraints and Opportunities for Development in Utah panel. June 11, 2021.

ULI Utah: Trends Conference—Water: Constraints and Opportunities for Development in Utah panel. October 27, 2021.

Exhibit 2

Resume for Norman L. Jones

Norman L. Jones, Ph.D.

Professor
Department of Civil & Construction Engineering
Brigham Young University

Education

Ph.D.	Civil Engineering, University of Texas at Austin, 1990
M.S.	Civil Engineering, University of Texas at Austin, 1988
B.S.	Civil Engineering, Brigham Young University, 1986

Academic Experience

Department Chair, Civil & Construction Engineering, Brigham Young University (BYU), 2018-2024
Professor, Civil & Construction Engineering, BYU, 2002–present
Associate Professor, Civil & Environmental Engineering, BYU, 1997–2002
Assistant Professor, Civil & Environmental Engineering, BYU, 1991–1996

Current Membership in Professional Organizations

American Society of Civil Engineers (ASCE)
American Water Resources Association (AWRA)
National Ground Water Association (NGWA)
American Geophysical Union (AGU)

Professional Committees

AWRA 2014 GIS in Water Resources Technical Program Chair
NGWA Groundwater Modeling Interest Group Committee
American Society of Civil Engineers
EWRI Groundwater Management Committee
EWRI Emerging Technologies Committee
International Editorial Board for the Journal of HydroInformatics
Editor of AQUAmundi Journal
Great Salt Lake Basin Integrated Plan - Groundwater Technical Advisory Team
Tethys Geoscience Foundation - Board Member

Selected Honors and Awards

2001 Walter L. Huber Civil Engineering Research Prize
2002 College of Engineering & Technology Special Commendation Award
2003 Brigham Young University Technology Transfer Award
2007 Utah Engineering Educator of the Year – ACEC
2012 Brigham Young University Karl G. Maeser Research and Creative Arts Award
2016 AWRA Educator of the Year – Utah Section
2021 NGWA John Hem Award for Science and Engineering
2023 Brigham Young University Sponsored Research Award

University Courses Taught

CE En 101 - Introduction to Civil and Environmental Engineering
CE En 201 - Infrastructure
CE En 270 – Computer Methods in Civil Engineering
CE En 341 – Elementary Soil Mechanics
CE En 540 – Geo-Environmental Engineering
CE EN 544 - Seepage and Slope Stability Analysis
CCE 547 – Ground Water Modeling

CE En 641 – Advanced Soil Mechanics

Software

Led the development of the Groundwater Modeling System (GMS) software. GMS is a state-of-the-art three-dimensional environment for ground water model construction and visualization. It includes tools for site characterization including geostatistics and solid modeling of soil stratigraphy. GMS is the most comprehensive and sophisticated groundwater modeling software available and is used by over 10,000 organizations in over 100 countries. Currently managed and distributed by Aquaveo, LLC, a company I co-founded in 2007.

External Research Grants

1. Automated Mesh Generation For the TABS-2 System, $19,000, 2/90 - 11/90, U.S. Army Engineer Waterways Experiment Station
2. A Geometry Pre-Processor for HEC-1 Employing Triangulated Irregular Networks, $20,048, 3/91 - 10/91, U.S. Army Engineer Waterways Experiment Station
3. Real-Time Visualization for the TABS-2 Modelling System, $14,123, 4/91 - 8/91, U.S. Army Engineer Waterways Experiment Station
4. An Investigation of X-Windows Interface Tools, $49,556, 1/92 - 8/92, U.S. Army Engineer Waterways Experiment Station
5. Descriptive Geometry and Solid Rendering, $24,000, 1/92 - 10/92, U.S. Army Engineer Waterways Experiment Station
6. An Investigation of Automated Pre-processing Schemes for TIN-Based Drainage Analysis, $34,750, 4/92-10/92, U.S. Army Engineer Waterways Experiment Station
7. A Comprehensive Graphical User Environment for Groundwater Flow and Transport Modeling, $246,526, 6/93-9/94, U.S. Army Engineer Waterways Experiment Station
8. An Integrated Surface Flow Modeling System, $131,848, 1/94-1/95, U.S. Army Engineer Waterways Experiment Station
9. Productivity and Management Tools for Groundwater Flow and Transport Modeling, $207,404, 5/94-4/95, U.S. Army Engineer Waterways Experiment Station
10. Enhanced Tools for Quality Control in Automated Groundwater Transport Modeling, $246,553, 1/95-12/95, U.S. Army Engineer Waterways Experiment Station
11. Visualization for Two-Dimensional Surface Runoff Modeling, $98,221, 1/95-10/95, U.S. Army Engineer Waterways Experiment Station
12. Visualization Tools for Two-Dimensional Finite Element Hydrologic Modeling, $93,933, 11/95-10/96, U.S. Army Engineer Waterways Experiment Station
13. A Graphical Environment for Multi-Dimensional Surface Water Modeling, $49,789, 3/96-9/96, U.S. Army Engineer Waterways Experiment Station
14. A Conceptual Modeling Approach to Pre-processing of Groundwater Models, $475,743, 11/95-11/97, U.S. Army Engineer Waterways Experiment Station
15. Hydrosystems Modeling, $2,458,083, 5/97-4/02, U.S. Army Engineer Waterways Experiment Station
16. Second Generation Hydroinformatics Research, $4,958,127. U.S. Army Engineer Research and Development Center.
17. Flux Calculations and 3D Visualization for the SCAPS Piezocone and GeoViz System, $34,931, U.S. Navy.
18. Development of modeling methods and tools for predicting coupled reactive transport processes in porous media under multiple scales. $949,000. US Dept. of Energy. 1/07-12/09.
19. CI-WATER: Cyberinfrastructure to Advance High Performance Water Resource Modeling, $3,435,873. National Science Foundation - EPSCoR. 9/11-8/14.

20. Comprehensive Streamflow Prediction and Visualization to Support Integrated Water Managment, $599,823. NASA SERVIR, 8/16-8/19.
21. Daniel P. Ames, E. James Nelson, Norman L. Jones, An AmeriGEOSS Cloud-based Platform for Rapid Deployment of GEOGLOWS Water and Food Security Decision Support Apps, $540,658, NASA GEO, 1/2018-12/2020
22. Geospatial Information Tools That Use Machine-Learning to Enable Sustainable Groundwater Management in West Africa, $657,232. NASA SERVIR, 11/19-11/22.
23. Advancing the NASA GEOGloWS Toolbox for Regional Water Resources Management and Decision Support. $1.2M. NASA GEOGLOWS. 2022-2025. Dan Ames, Jim Nelson, Gus Williams, Norm Jones.
24. CIROH: National Cyberinfrastructure Framework for Engaging the Hydrologic Community (NCF). $1,822,418. National Oceanographic and Atmospheric Administration. 2022-2025. Dan Ames, Jim Nelson, Gus Williams, Norm Jones.
25. CIROH: Advancing Science to Better Characterize Drought and Groundwater-Driven Low-Flow Conditions in NOAA and USGS National-Scale Models. $801,221. 2023-2025. Norm Jones, Gus Williams, T. Prabhakar Clement, Donna Rizzo.
26. Improved Hydrologic Prediction Services for Resilience with GEOGLOWS, $1,889,627, National Oceanic and Atmospheric Administration (NOAA), 4/1/2024-3/31/2027. Norm Jones, Jim Nelson, Andrew South.

Summary: PI or Co-PI on 26 projects totaling $22,026,639.

Peer-Reviewed Publications in the Past 10 Years

1. Jones, N., Nelson, J., Swain, N., Christensen, S., Tarboton, D. Dash, P. Tethys: A Software Framework for Web-Based Modeling and Decision Support Applications. In: Ames, D.P., Quinn, N.W.T., Rizzoli, A.E. (Eds.), Proceedings of the 7th International Congress on Environmental Modelling and Software, June 15-19, San Diego, California, USA. ISBN: 978-88-9035-744-2
2. Jones, N., Griffiths, T., Lemon, A., Kudlas, S. Automated Well Permitting in Virginia's Coastal Plain Using SEAWAT and GIS Geoprocessing Tools. In: Ames, D.P., Quinn, N.W.T., Rizzoli, A.E. (Eds.), Proceedings of the 7th International Congress on Environmental Modelling and Software, June 15-19, San Diego, California, USA. ISBN: 978-88-9035-744-2
3. Y. Fan, S. Richard, R. S. Bristol, S. E. Peters, S. E. Ingebritsen, N. Moosdorf, A. Packman, T. Gleeson, I. Zaslavsky, S. Peckham, L. Murdoch, M. Fienen, M. Cardiff, D. Tarboton, N. Jones, R. Hooper, J. Arrigo, D. Gochis, J. Olson and D. Wolock (2014), DigitalCrust – a 4D data system of material properties for transforming research on crustal fluid flow, *GeoFluids*, Article first published online: 7 OCT 2014 | DOI: 10.1111/gfl.12114.
4. Swain, N.R., K. Latu, S.D. Christensen, N.L. Jones, E.J. Nelson, D.P. Ames, G.P. Williams (2015). "A review of open source software solutions for developing water resources web applications." Environmental Modeling & Software 67: 108-117.
5. Jones, David, Norm Jones, James Greer, and Jim Nelson, "*A cloud-based MODFLOW service for aquifer management decision support,*" Computers and GeoSciences, Vol. 78, pp. 81-87, 2015.
6. Dolder, H., Jones, N., and Nelson, E. (2015). "Simple Method for Using Precomputed Hydrologic Models in Flood Forecasting with Uniform Rainfall and Soil Moisture Pattern." *J. Hydrol. Eng.,*10.1061/(ASCE)HE.1943-5584.0001232 , 04015039.
7. Fatichi, S., Vivoni, E.R., Ogden, F.L., Ivanov, V.Y., Mirus, B., Gochis, D., Downer, C.W., Camporese, M., Davidson, J.H., Ebel, B., Jones, N., Kim, J., Mascaro, G., Niswonger, R., Restrepo, P., Rigon, R., Shen, C., Sulis, M., and Tarboton, D. (2016). *An Overview of Challenges, Current Applications and Future Trends of Distributed Process-based Models in Hydrology*.

Journal of Hydrology. Vol 537, 45-60. DOI:10.1016/j.jhydrol.2016.03.026
8. Snow, Alan D., Scott D. Christensen, Nathan R. Swain, E. James Nelson, Daniel P. Ames, Norman L. Jones, Deng Ding, Nawajish S. Noman, Cédric H. David, Florian Pappenberger, and Ervin Zsoter, 2016. *A High-Resolution National-Scale Hydrologic Forecast System from a Global Ensemble Land Surface Model*. Journal of the American Water Resources Association (JAWRA) 52(4):950–964, DOI: 10.1111/1752-
9. Perez, J. Fidel, Nathan R. Swain, Herman G. Dolder, Scott D. Christensen, Alan D. Snow, E. James Nelson, and Norman L. Jones, 2016. *From Global to Local: Providing Actionable Flood Forecast Information in a Cloud-Based Computing Environment*. Journal of the American Water Resources Association (JAWRA) 52(4):965–978. DOI: 10.1111/1752-1688.12392
10. Swain, N. R., S. D. Christensen, A. D. Snow, H. Dolder, G. Espinoza-Dávalos, E. Goharian, N. L. Jones, E. J. Nelson, D. P. Ames and S. J. Burian (2016). "A new open source platform for lowering the barrier for environmental web app development." Environmental Modelling & Software 85: 11-26.
11. Souffront Alcantara, Michael A.; Crawley, Shawn; Stealey, Michael J.; Nelson, E. James; Ames, Daniel P.; and Jones, Norm L. (2017) "Open Water Data Solutions for Accessing the National Water Model," Open Water Journal: Vol. 4 : Iss. 1 , Article 3.
12. Souffront Alcantara, Michael, C Kesler, M Stealey, J Nelson, D Ames, N Jones, 2017. Cyberinfrastructure and Web Apps for Managing and Disseminating the National Water Model, *Journal of the American Water Resources Association*, *JAWRA Journal of the American Water Resources Association* 54, no. 4 (2018): 859-871.
13. Christensen, Scott D., Nathan R. Swain, Norman L. Jones, E. James Nelson, Alan D. Snow, and Herman G. Dolder. "A Comprehensive Python Toolkit for Accessing High-Throughput Computing to Support Large Hydrologic Modeling Tasks." *JAWRA Journal of the American Water Resources Association* 53, no. 2 (2017): 333-343.
14. Nelson, E. J., Pulla, S. T., Matin, M. A., Shakya, K., Jones, N., Ames, D. P., Ellenberg, W.L., Markert, K.N., Hales, R. (2019). Enabling Stakeholder Decision-Making With Earth Observation and Modeling Data Using Tethys Platform. *Frontiers in Environmental Science*, *7*. https://doi.org/10.3389/fenvs.2019.00148
15. Purdy, A. J., David, C. H., Sikder, M. S., Reager, J. T., Chandanpurkar, H. A., Jones, N. L., & Matin, M. A. (2019). An Open-Source Tool to Facilitate the Processing of GRACE Observations and GLDAS Outputs: An Evaluation in Bangladesh. *Frontiers in Environmental Science*, 7. https://doi.org/10.3389/fenvs.2019.00155
16. Souffront Alcantara, M. A., Nelson, E. J., Shakya, K., Edwards, C., Roberts, W., Krewson, C., Ames, D. P., Jones, N. L., Gutierrez, A. (2019). Hydrologic Modeling as a Service (HMaaS): A New Approach to Address Hydroinformatic Challenges in Developing Countries. *Frontiers in Environmental Science*, 7. https://doi.org/10.3389/fenvs.2019.00158
17. Evans, S.; Williams, G.P.; Jones, N.L.; Ames, D.P.; Nelson, E.J. Exploiting Earth Observation Data to Impute Groundwater Level Measurements with an Extreme Learning Machine. *Remote Sens.* 2020, *12*, 2044. https://doi.org/10.3390/rs12122044
18. Evans, S.W.; Jones, N.L.; Williams, G.P.; Ames, D.P.; Nelson, E.J. (2020). Groundwater Level Mapping Tool: An open source web application for assessing groundwater sustainability. *Environmental Modeling and Software*, Vol 131, September 2020. https://doi.org/10.1016/j.envsoft.2020.104782
19. Nelson, S. T., Robinson, S., Rey, K., Brown, L., Jones, N., Dawrs, S. N., et al. (2021). Exposure Pathways of Nontuberculous Mycobacteria Through Soil, Streams, and Groundwater, Hawai'i, USA. *GeoHealth*, 5, e2020GH000350. https://doi.org/10.1029/2020GH000350
20. Sanchez Lozano J, Romero Bustamante G, Hales R, Nelson EJ, Williams GP, Ames DP, Jones NL. A Streamflow Bias Correction and Performance Evaluation Web Application for GEOGloWS ECMWF Streamflow Services. *Hydrology*. 2021;

8(2):71. https://doi.org/10.3390/hydrology8020071
21. Dolder, Danisa; Williams, Gustavious P.; Miller, A. W.; Nelson, Everett J.; Jones, Norman L.; Ames, Daniel P. 2021. "Introducing an Open-Source Regional Water Quality Data Viewer Tool to Support Research Data Access" *Hydrology* 8, no. 2: 91. https://doi.org/10.3390/hydrology8020091
22. Bustamante, G.R.; Nelson, E.J.; Ames, D.P.; Williams, G.P.; Jones, N.L.; Boldrini, E.; Chernov, I.; Sanchez Lozano, J.L. Water Data Explorer: An Open-Source Web Application and Python Library for Water Resources Data Discovery. *Water* 2021, *13*, 1850. https://doi.org/10.3390/w131318500
23. Hales, R.C.C.; Nelson, E.J.J.; Williams, G.P.P.; Jones, N.; Ames, D.P.P.; Jones, J.E.E. The Grids Python Tool for Querying Spatiotemporal Multidimensional Water Data. *Water* 2021, *13*, 2066. https://doi.org/10.3390/w13152066
24. Khattar, R., Hales, R., Ames, D. P., Nelson, E. J., Jones, N., & Williams, G. (2021). Tethys App Store: Simplifying deployment of web applications for the international GEOGloWS initiative. *Environmental Modelling & Software*, 105227. https://doi.org/10.1016/j.envsoft.2021.105227
25. McStraw, T.C., Pulla, S.T., Jones, N.L., Williams, G.P., David, C.H., Nelson, J.E., and Ames, D.P.. 2021. "An Open-Source Web Application for Regional Analysis of GRACE Groundwater Data and Engaging Stakeholders in Groundwater Management." *Journal of the American Water Resources Association* 1– 15. https://doi.org/10.1111/1752-1688.12968.
26. Barbosa, S.A.; Pulla, S.T.; Williams, G.P.; Jones, N.L.; Mamane, B.; Sanchez, J.L. Evaluating Groundwater Storage Change and Recharge Using GRACE Data: A Case Study of Aquifers in Niger, West Africa. *Remote Sens.* 2022, *14*, 1532. https://doi.org/10.3390/rs14071532
27. Nishimura, R.; Jones, N.L.; Williams, G.P.; Ames, D.P.; Mamane, B.; Begou, J. Methods for Characterizing Groundwater Resources with Sparse In Situ Data. *Hydrology* 2022, *9*, 134. https://doi.org/10.3390/hydrology9080134
28. Ramirez, S. G., Hales, R. C., Williams, G. P., & Jones, N. L. (2022). Extending SC-PDSI-PM with neural network regression using GLDAS data and Permutation Feature Importance. *Environmental Modelling & Software*, 105475. https://doi.org/10.1016/j.envsoft.2022.105475
29. Hales, R. C., Nelson, E. J., Souffront, M., Gutierrez, A. L., Prudhomme, C., Kopp, S., Ames, D. P., Williams, G. P., & Jones, N. L. (2022) Advancing global hydrologic modeling with the GEOGloWS ECMWF streamflow service. *Journal of Flood Risk Management*, e12859. https://doi.org/10.1111/jfr3.12859
30. Ramirez, S.G.; Williams, G.P.; Jones, N.L. (2022) Groundwater Level Data Imputation Using Machine Learning and Remote Earth Observations Using Inductive Bias. *Remote Sens.* 2022, *14*, 5509. https://doi.org/10.3390/rs14215509
31. Jones, J.E.; Hales, R.C.; Larco, K.; Nelson, E.J.; Ames, D.P.; Jones, N.L.; Iza, M. (2023) Building and Validating Multidimensional Datasets in Hydrology for Data and Mapping Web Service Compliance. Water 2023, 15, 411. https://doi.org/10.3390/w15030411
32. Ramirez, S.G.; Williams, G.P.; Jones, N.L.; Ames, D.P.; Radebaugh, J. (2023) Improving Groundwater Imputation through Iterative Refinement Using Spatial and Temporal Correlations from In Situ Data with Machine Learning. Water 2023, 15, 1236. https://doi.org/10.3390/w15061236
33. Jones, N.L. and Mayo, A.L. (2023), Urban Thirst and Rural Water – The Saga of the Southern Nevada Groundwater Development Project. Groundwater. https://doi.org/10.1111/gwat.13364
34. Barbosa, S.A.; Jones, N.L.; Williams, G.P.; Mamane, B.; Begou, J.; Nelson, E.J.; Ames, D.P. (2023) Exploiting Earth Observations to Enable Groundwater Modeling in the Data-Sparse Region of Goulbi Maradi, Niger. *Remote Sens.* 2023, *15*,

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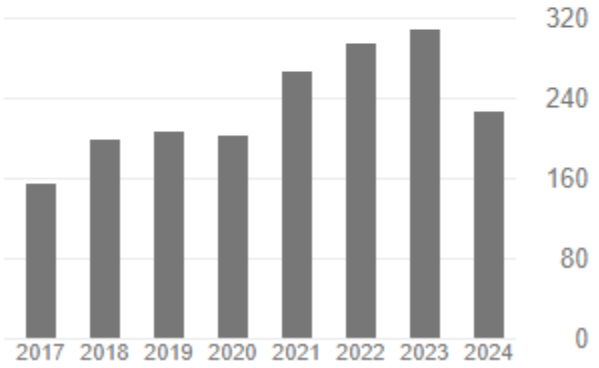

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Appendix A

Updated Tables and Figures

Table A1. Observed and Simulated PCE Concentrations at Monitoring Well Locations (Compare to Table 5 in Post-Audit Report)

Date	Monitoring Well	PCE Observed Concentration (µg/L)	PCE Simulated Concentration (µg/L)	Error	Absolute Error
2/1/2000	C1	<DL	0.04	0.04	0.04
5/1/2002	C1	<DL	0.03	0.03	0.03
8/1/2002	C1	<DL	0.03	0.03	0.03
11/1/2002	C1	<DL	0.03	0.03	0.03
3/1/2003	C1	<DL	0.03	0.03	0.03
3/1/2004	C1	<DL	0.03	0.03	0.03
3/1/2005	C1	<DL	0.03	0.03	0.03
3/1/2006	C1	<DL	0.02	0.02	0.02
2/1/2007	C1	<DL	0.02	0.02	0.02
3/1/2008	C1	<DL	0.02	0.02	0.02
6/1/1997	C2	<DL	1316.4	1316.4	1316.4
2/1/2000	C2	<DL	900.8	900.8	900.8
5/1/2002	C2	1	580.6	579.6	579.6
8/1/2002	C2	<DL	548.86	548.86	548.86
11/1/2002	C2	<DL	518.92	518.92	518.92
3/1/2003	C2	<DL	482.65	482.65	482.65
3/1/2004	C2	<DL	389.28	389.28	389.28
3/1/2005	C2	<DL	321.59	321.59	321.59
3/1/2006	C2	1.4	261.33	259.93	259.93
2/1/2007	C2	<DL	214.18	214.18	214.18
3/1/2008	C2	<DL	176.88	176.88	176.88
6/1/1997	C3	580	434.52	-145.48	145.48
2/1/2000	C3	410	439.84	29.84	29.84
5/1/2002	C3	270	307.28	37.28	37.28
8/1/2002	C3	140	290.84	150.84	150.84
11/1/2002	C3	100	275.9	175.9	175.9
3/1/2003	C3	150	258.55	108.55	108.55
3/1/2004	C3	58	218.29	160.29	160.29
3/1/2005	C3	37	201.45	164.45	164.45
3/1/2006	C3	38	177.93	139.93	139.93
2/1/2007	C3	23	153.16	130.16	130.16
3/1/2008	C3	22	148.59	126.59	126.59
6/1/1997	C4	<DL	1.96	1.96	1.96
2/1/2000	C4	<DL	2.32	2.32	2.32
1/1/2002	C4	<DL	1.9	1.9	1.9
5/1/2002	C4	<DL	1.85	1.85	1.85
8/1/2002	C4	<DL	1.81	1.81	1.81
11/1/2002	C4	<DL	1.78	1.78	1.78
3/1/2003	C4	<DL	1.74	1.74	1.74
3/1/2004	C4	<DL	1.64	1.64	1.64
3/1/2005	C4	<DL	1.62	1.62	1.62
3/1/2006	C4	0.51	1.54	1.03	1.03
2/1/2007	C4	<DL	1.47	1.47	1.47
3/1/2008	C4	<DL	1.38	1.38	1.38
6/1/1997	C5	<DL	1326.87	1326.87	1326.87
2/1/2000	C5	<DL	1190.26	1190.26	1190.26
5/1/2002	C5	<DL	1009.86	1009.86	1009.86
8/1/2002	C5	<DL	985.68	985.68	985.68

Table A1. Observed and Simulated PCE Concentrations at Monitoring Well Locations (Compare to Table 5 in Post-Audit Report)

Date	Monitoring Well	PCE Observed Concentration (µg/L)	PCE Simulated Concentration (µg/L)	Error	Absolute Error
11/1/2002	C5	<DL	961.76	961.76	961.76
3/1/2003	C5	<DL	931.03	931.03	931.03
3/1/2004	C5	<DL	839.91	839.91	839.91
3/1/2005	C5	<DL	772.91	772.91	772.91
3/1/2006	C5	<DL	690.68	690.68	690.68
2/1/2007	C5	<DL	613.37	613.37	613.37
3/1/2008	C5	<DL	551.21	551.21	551.21
6/1/1997	C9	<DL	0.06	0.06	0.06
2/1/2000	C9	<DL	0.16	0.16	0.16
5/1/2002	C9	1	0.18	-0.82	0.82
8/1/2002	C9	<DL	0.18	0.18	0.18
11/1/2002	C9	0.48	0.18	-0.3	0.3
3/1/2003	C9	<DL	0.18	0.18	0.18
3/1/2004	C9	1.9	0.18	-1.72	1.72
3/1/2005	C9	7.4	0.19	-7.21	7.21
3/1/2006	C9	18	0.19	-17.81	17.81
2/1/2007	C9	20	0.18	-19.82	19.82
3/1/2008	C9	18	0.17	-17.83	17.83
6/1/1997	C10	<DL	222.31	222.31	222.31
2/1/2000	C10	<DL	199.93	199.93	199.93
5/1/2002	C10	<DL	73.7	73.7	73.7
8/1/2002	C10	<DL	69.19	69.19	69.19
11/1/2002	C10	0.16	65.02	64.86	64.86
3/1/2003	C10	<DL	60.18	60.18	60.18
3/1/2004	C10	<DL	49.48	49.48	49.48
3/1/2005	C10	<DL	40.32	40.32	40.32
3/1/2006	C10	<DL	38.86	38.86	38.86
2/1/2007	C10	0.48	35.65	35.17	35.17
3/1/2008	C10	<DL	30.46	30.46	30.46
1/1/2002	C12	15	190.3	175.3	175.3
5/1/2002	C12	7	188.12	181.12	181.12
8/1/2002	C12	1.7	186.68	184.98	184.98
11/1/2002	C12	<DL	185.33	185.33	185.33
3/1/2003	C12	<DL	183.96	183.96	183.96
3/1/2004	C12	<DL	182.37	182.37	182.37
3/1/2005	C12	<DL	181.97	181.97	181.97
3/1/2006	C12	<DL	178.52	178.52	178.52
2/1/2007	C12	<DL	169.07	169.07	169.07
3/1/2008	C12	<DL	157.22	157.22	157.22
1/1/2002	C13	5400	15.21	-5384.79	5384.79
5/1/2002	C13	140	14.7	-125.3	125.3
8/1/2002	C13	68	14.34	-53.66	53.66
11/1/2002	C13	44	13.98	-30.02	30.02
3/1/2003	C13	6	13.57	7.57	7.57
3/1/2004	C13	3	12.66	9.66	9.66
3/1/2005	C13	2.8	11.81	9.01	9.01
3/1/2006	C13	2.5	11.1	8.6	8.6

Table A1. Observed and Simulated PCE Concentrations at Monitoring Well Locations (Compare to Table 5 in Post-Audit Report)

Date	Monitoring Well	PCE Observed Concentration (µg/L)	PCE Simulated Concentration (µg/L)	Error	Absolute Error
2/1/2007	C13	2.7	10.12	7.42	7.42
3/1/2008	C13	7.8	8.83	1.03	1.03
3/1/2005	C14	1800	2.5	-1797.5	1797.5
3/1/2006	C14	1300	2.48	-1297.52	1297.52
2/1/2007	C14	320	2.37	-317.63	317.63
3/1/2008	C14	120	2.17	-117.83	117.83
2/1/2007	C15-D	1.9	0	-1.9	1.9
3/1/2008	C15-D	0.27	0	-0.27	0.27
2/1/2007	C15-S	3.8	0.7	-3.1	3.1
3/1/2008	C15-S	3.8	0.72	-3.08	3.08
2/1/2007	C16	0.36	1.06	0.7	0.7
3/1/2008	C16	<DL	1.12	1.12	1.12
2/1/2007	C17-D	0.77	0.15	-0.62	0.62
3/1/2008	C17-D	<DL	0.18	0.18	0.18
2/1/2007	C17-S	1.2	0.15	-1.05	1.05
3/1/2008	C17-S	0.19	0.18	-0.01	0.01
2/1/2007	C18	0.41	57.22	56.81	56.81
3/1/2008	C18	0.84	57.87	57.03	57.03
6/1/1997	FWC-11	<DL	840.57	840.57	840.57
2/1/2000	FWC-11	<DL	815.82	815.82	815.82
1/1/2002	FWC-11	<DL	760.83	760.83	760.83
5/1/2002	FWC-11	<DL	746.89	746.89	746.89
8/1/2002	FWC-11	<DL	736.19	736.19	736.19
11/1/2002	FWC-11	<DL	725.49	725.49	725.49
3/1/2003	FWC-11	<DL	711.68	711.68	711.68
3/1/2004	FWC-11	<DL	670.83	670.83	670.83
3/1/2005	FWC-11	<DL	641.83	641.83	641.83
3/1/2006	FWC-11	<DL	601.95	601.95	601.95
2/1/2007	FWC-11	<DL	556.03	556.03	556.03
3/1/2008	FWC-11	<DL	514.79	514.79	514.79
6/1/1997	FWS-12	230	605.2	375.2	375.2
2/1/2000	FWS-12	190	607.3	417.3	417.3
1/1/2002	FWS-12	100	362.09	262.09	262.09
5/1/2002	FWS-12	92	340.91	248.91	248.91
8/1/2002	FWS-12	90	323.49	233.49	233.49
11/1/2002	FWS-12	67	306.42	239.42	239.42
3/1/2003	FWS-12	96	285.52	189.52	189.52
3/1/2004	FWS-12	100	236.65	136.65	136.65
3/1/2005	FWS-12	64	226.34	162.34	162.34
3/1/2006	FWS-12	30	194.09	164.09	164.09
2/1/2007	FWS-12	26	131.8	105.8	105.8
3/1/2008	FWS-12	12	94.64	82.64	82.64
6/1/1997	FWS-13	<DL	1215.23	1215.23	1215.23
2/1/2000	FWS-13	<DL	1107.38	1107.38	1107.38
1/1/2002	FWS-13	1	959.83	958.83	958.83
5/1/2002	FWS-13	3	917.47	914.47	914.47
8/1/2002	FWS-13	1.2	883.55	882.35	882.35

Table A1. Observed and Simulated PCE Concentrations at Monitoring Well Locations (Compare to Table 5 in Post-Audit Report)

Date	Monitoring Well	PCE Observed Concentration (µg/L)	PCE Simulated Concentration (µg/L)	Error	Absolute Error
11/1/2002	FWS-13	2.9	848.85	845.95	845.95
3/1/2003	FWS-13	2	802.06	800.06	800.06
3/1/2004	FWS-13	<DL	658.46	658.46	658.46
3/1/2005	FWS-13	1.9	543.52	541.62	541.62
3/1/2006	FWS-13	4.2	429.96	425.76	425.76
2/1/2007	FWS-13	1.5	341.03	339.53	339.53
3/1/2008	FWS-13	0.86	259.6	258.74	258.74
5/1/2002	RWC-1	155	360.92	205.92	205.92
8/1/2002	RWC-1	360	356.8	-3.2	3.2
11/1/2002	RWC-1	29	352.36	323.36	323.36
3/1/2003	RWC-1	22	346.48	324.48	324.48
3/1/2004	RWC-1	17	329.75	312.75	312.75
3/1/2005	RWC-1	5	316.15	311.15	311.15
3/1/2006	RWC-1	1.9	298.96	297.06	297.06
2/1/2007	RWC-1	12	270	258	258
3/1/2008	RWC-1	9.1	246.9	237.8	237.8
2/1/2000	RWC-2	1800	124.38	-1675.62	1675.62
1/1/2002	RWC-2	1350	102.55	-1247.45	1247.45
5/1/2002	RWC-2	1700	98.4	-1601.6	1601.6
8/1/2002	RWC-2	2300	95.58	-2204.42	2204.42
11/1/2002	RWC-2	2000	92.98	-1907.02	1907.02
3/1/2003	RWC-2	2000	90.16	-1909.84	1909.84
3/1/2004	RWC-2	2200	84.29	-2115.71	2115.71
3/1/2005	RWC-2	1400	76.21	-1323.79	1323.79
3/1/2006	RWC-2	1800	75.2	-1724.8	1724.8
2/1/2007	RWC-2	2300	69.28	-2230.72	2230.72
3/1/2008	RWC-2	2100	60.39	-2039.61	2039.61
5/1/2002	RWS-1A	8	380.65	372.65	372.65
8/1/2002	RWS-1A	<DL	342.01	342.01	342.01
11/1/2002	RWS-1A	5	308.75	303.75	303.75
3/1/2003	RWS-1A	6	270.86	264.86	264.86
3/1/2004	RWS-1A	2.6	187.28	184.68	184.68
3/1/2005	RWS-1A	2	141.68	139.68	139.68
3/1/2006	RWS-1A	1.8	111.86	110.06	110.06
2/1/2007	RWS-1A	2.7	93.16	90.46	90.46
3/1/2008	RWS-1A	2.1	56.99	54.89	54.89
5/1/2002	RWS-2A	79	609.72	530.72	530.72
1/1/2002	RWS-2A	17	697.9	680.9	680.9
8/1/2002	RWS-2A	290	554.12	264.12	264.12
11/1/2002	RWS-2A	98	505.35	407.35	407.35
3/1/2003	RWS-2A	170	450	280	280
3/1/2004	RWS-2A	40	322.81	282.81	282.81
3/1/2005	RWS-2A	42	231.7	189.7	189.7
3/1/2006	RWS-2A	50	195.03	145.03	145.03
2/1/2007	RWS-2A	15	155.12	140.12	140.12
3/1/2008	RWS-2A	16	105.2	89.2	89.2
1/1/2002	RWS-3A	760	734.63	-25.37	25.37

Table A1. Observed and Simulated PCE Concentrations at Monitoring Well Locations (Compare to Table 5 in Post-Audit Report)

Date	Monitoring Well	PCE Observed Concentration (µg/L)	PCE Simulated Concentration (µg/L)	Error	Absolute Error
5/1/2002	RWS-3A	920	685.63	-234.37	234.37
8/1/2002	RWS-3A	970	647.45	-322.55	322.55
11/1/2002	RWS-3A	500	609.53	109.53	109.53
3/1/2003	RWS-3A	810	562.36	-247.64	247.64
3/1/2004	RWS-3A	280	435.76	155.76	155.76
3/1/2005	RWS-3A	560	342.42	-217.58	217.58
3/1/2006	RWS-3A	280	277.36	-2.64	2.64
2/1/2007	RWS-3A	260	213.69	-46.31	46.31
3/1/2008	RWS-3A	160	157.95	-2.05	2.05
1/1/2002	RWS-4A	280	413.29	133.29	133.29
5/1/2002	RWS-4A	6900	406.97	-6493.03	6493.03
8/1/2002	RWS-4A	3700	399.1	-3300.9	3300.9
11/1/2002	RWS-4A	3100	389.75	-2710.25	2710.25
3/1/2003	RWS-4A	1100	377.41	-722.59	722.59
3/1/2004	RWS-4A	<DL	337.47	337.47	337.47
3/1/2005	RWS-4A	1000	276.72	-723.28	723.28
3/1/2006	RWS-4A	92	251.29	159.29	159.29
2/1/2007	RWS-4A	1600	209.57	-1390.43	1390.43
3/1/2008	RWS-4A	1900	157.5	-1742.5	1742.5
6/1/1997	S1	5.6	0.11	-5.49	5.49
2/1/2000	S1	<DL	0.06	0.06	0.06
5/1/2002	S1	<DL	0.03	0.03	0.03
8/1/2002	S1	<DL	0.03	0.03	0.03
11/1/2002	S1	0.32	0.03	-0.29	0.29
3/1/2003	S1	<DL	0.02	0.02	0.02
3/1/2004	S1	<DL	0.02	0.02	0.02
3/1/2005	S1	<DL	0.01	0.01	0.01
3/1/2006	S1	<DL	0.01	0.01	0.01
2/1/2007	S1	<DL	0.01	0.01	0.01
3/1/2008	S1	<DL	0.01	0.01	0.01
6/1/1997	S2	<DL	207.79	207.79	207.79
2/1/2000	S2	520	95.18	-424.82	424.82
5/1/2002	S2	340	38.63	-301.37	301.37
8/1/2002	S2	110	34.41	-75.59	75.59
11/1/2002	S2	67	30.73	-36.27	36.27
3/1/2003	S2	100	26.65	-73.35	73.35
3/1/2004	S2	50	18.16	-31.84	31.84
3/1/2005	S2	35	13.62	-21.38	21.38
3/1/2006	S2	38	10.18	-27.82	27.82
2/1/2007	S2	22	7.79	-14.21	14.21
3/1/2008	S2	20	6.57	-13.43	13.43
6/1/1997	S3	77	1321.69	1244.69	1244.69
2/1/2000	S3	12	1001.42	989.42	989.42
5/1/2002	S3	23	451.57	428.57	428.57
8/1/2002	S3	54	397.13	343.13	343.13
11/1/2002	S3	60	352.03	292.03	292.03
3/1/2003	S3	48	303.81	255.81	255.81

Table A1. Observed and Simulated PCE Concentrations at Monitoring Well Locations (Compare to Table 5 in Post-Audit Report)

Date	Monitoring Well	PCE Observed Concentration (µg/L)	PCE Simulated Concentration (µg/L)	Error	Absolute Error
3/1/2004	S3	53	207.92	154.92	154.92
3/1/2005	S3	47	167.82	120.82	120.82
3/1/2006	S3	23	119.56	96.56	96.56
2/1/2007	S3	85	91.67	6.67	6.67
3/1/2008	S3	94	82.39	-11.61	11.61
6/1/1997	S4	<DL	102.72	102.72	102.72
2/1/2000	S4	<DL	121.75	121.75	121.75
3/1/2004	S4	<DL	29.29	29.29	29.29
3/1/2005	S4	<DL	22.94	22.94	22.94
3/1/2006	S4	<DL	16.81	16.81	16.81
2/1/2007	S4	<DL	13.37	13.37	13.37
3/1/2008	S4	<DL	10.24	10.24	10.24
6/1/1997	S5	<DL	1773.95	1773.95	1773.95
2/1/2000	S5	<DL	1136.51	1136.51	1136.51
5/1/2002	S5	<DL	584.04	584.04	584.04
8/1/2002	S5	<DL	534.73	534.73	534.73
11/1/2002	S5	1	489.23	488.23	488.23
3/1/2003	S5	<DL	434.22	434.22	434.22
3/1/2004	S5	<DL	295.95	295.95	295.95
3/1/2005	S5	<DL	216.07	216.07	216.07
3/1/2006	S5	<DL	150.33	150.33	150.33
2/1/2007	S5	<DL	109.32	109.32	109.32
3/1/2008	S5	<DL	80.8	80.8	80.8
6/1/1997	S6	<DL	21.11	21.11	21.11
2/1/2000	S6	<DL	10.5	10.5	10.5
8/1/2002	S6	<DL	4.26	4.26	4.26
11/1/2002	S6	0.2	3.85	3.65	3.65
3/1/2003	S6	<DL	3.38	3.38	3.38
3/1/2004	S6	<DL	2.35	2.35	2.35
3/1/2005	S6	<DL	1.73	1.73	1.73
3/1/2006	S6	<DL	1.28	1.28	1.28
2/1/2007	S6	<DL	0.97	0.97	0.97
3/1/2008	S6	<DL	0.74	0.74	0.74
6/1/1997	S7	<DL	134.14	134.14	134.14
8/1/2002	S7	<DL	23.27	23.27	23.27
11/1/2002	S7	<DL	20.84	20.84	20.84
3/1/2003	S7	0.5	18.07	17.57	17.57
3/1/2004	S7	<DL	11.97	11.97	11.97
3/1/2005	S7	<DL	8.59	8.59	8.59
3/1/2006	S7	1.9	6.02	4.12	4.12
2/1/2007	S7	<DL	4.38	4.38	4.38
3/1/2008	S7	<DL	3.64	3.64	3.64
6/1/1997	S8	<DL	27.91	27.91	27.91
2/1/2000	S8	<DL	22.16	22.16	22.16
5/1/2002	S8	<DL	9.98	9.98	9.98
8/1/2002	S8	<DL	8.89	8.89	8.89
11/1/2002	S8	<DL	7.93	7.93	7.93

Table A1. Observed and Simulated PCE Concentrations at Monitoring Well Locations (Compare to Table 5 in Post-Audit Report)

Date	Monitoring Well	PCE Observed Concentration (µg/L)	PCE Simulated Concentration (µg/L)	Error	Absolute Error
3/1/2003	S8	<DL	6.85	6.85	6.85
3/1/2004	S8	<DL	4.54	4.54	4.54
3/1/2005	S8	<DL	3.2	3.2	3.2
3/1/2006	S8	<DL	2.16	2.16	2.16
2/1/2007	S8	<DL	1.46	1.46	1.46
3/1/2008	S8	<DL	1.01	1.01	1.01
6/1/1997	S9	<DL	57.92	57.92	57.92
2/1/2000	S9	<DL	73.25	73.25	73.25
5/1/2002	S9	<DL	35.02	35.02	35.02
8/1/2002	S9	<DL	31.03	31.03	31.03
11/1/2002	S9	<DL	27.5	27.5	27.5
3/1/2003	S9	<DL	23.55	23.55	23.55
3/1/2004	S9	<DL	15.17	15.17	15.17
3/1/2005	S9	<DL	11.39	11.39	11.39
3/1/2006	S9	<DL	7.41	7.41	7.41
2/1/2007	S9	<DL	4.68	4.68	4.68
3/1/2008	S9	<DL	3.25	3.25	3.25
6/1/1997	S10	<DL	505.27	505.27	505.27
2/1/2000	S10	<DL	503.55	503.55	503.55
1/1/2002	S10	<DL	484.38	484.38	484.38
5/1/2002	S10	<DL	477.98	477.98	477.98
8/1/2002	S10	<DL	473.09	473.09	473.09
11/1/2002	S10	0.16	468.13	467.97	467.97
3/1/2003	S10	<DL	461.09	461.09	461.09
3/1/2004	S10	<DL	438.9	438.9	438.9
3/1/2005	S10	<DL	418.76	418.76	418.76
3/1/2006	S10	<DL	390.31	390.31	390.31
2/1/2007	S10	0.74	360.66	359.92	359.92
3/1/2008	S10	<DL	330.09	330.09	330.09
6/1/1997	S11	<DL	<DL	0	0
2/1/2000	S11	<DL	<DL	0	0
3/1/2005	S14	<DL	10.43	10.43	10.43
3/1/2006	S14	<DL	8.57	8.57	8.57
2/1/2007	S14	0.47	6.94	6.47	6.47
3/1/2008	S14	<DL	5.34	5.34	5.34

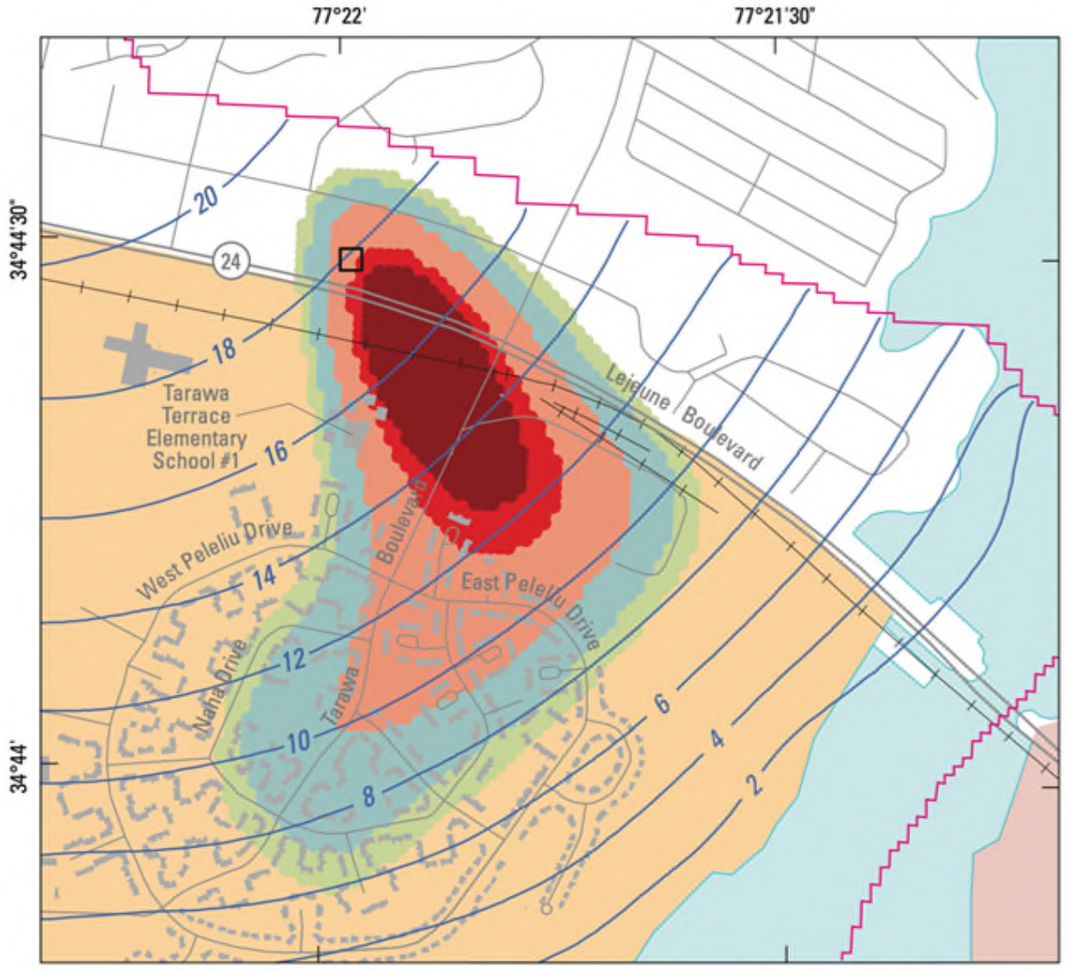
Notes:
<DL = sample result reported below the detection limit
PCE = tetrachloroethylene

Table A2. Mean Error and Mean Absolute Error for Monitoring Wells (Compare to Table 6 in Post-Audit Report)

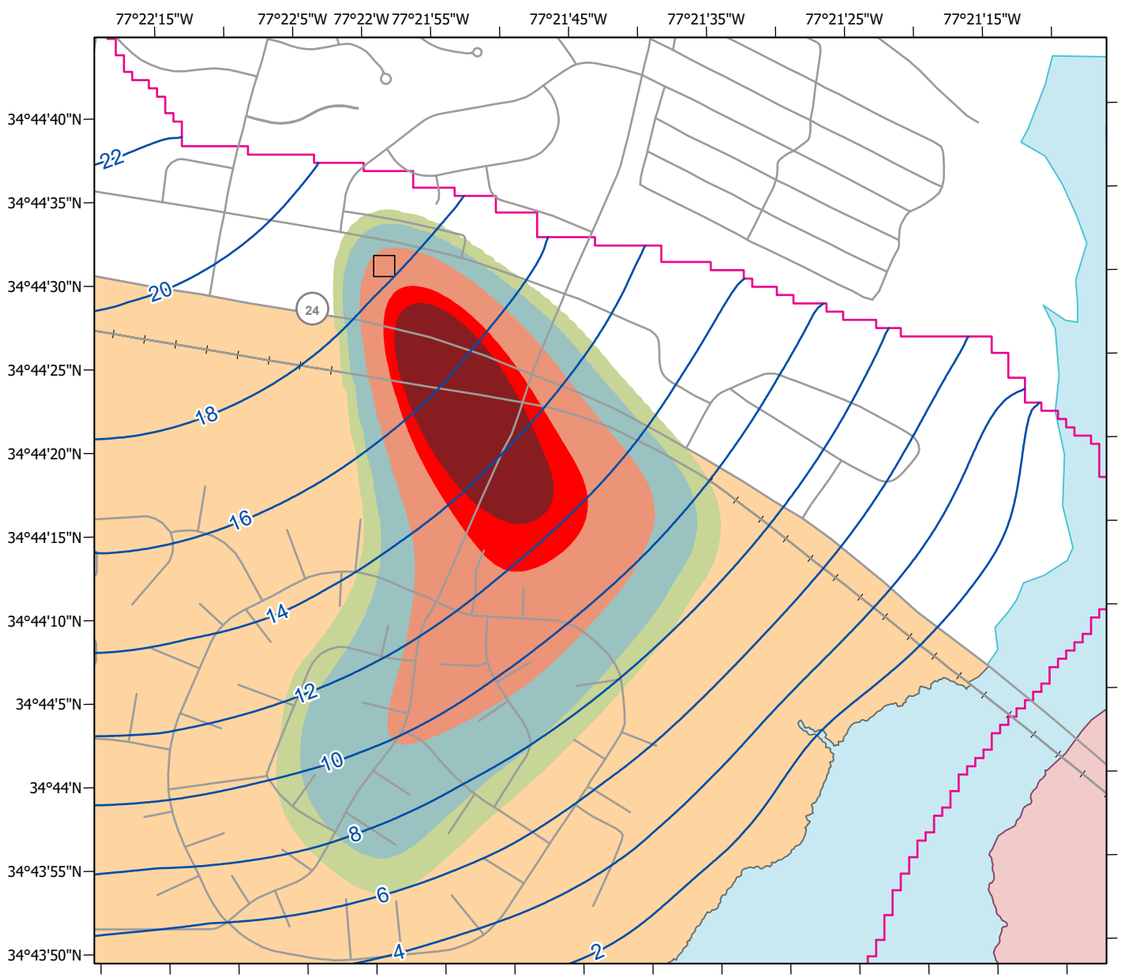
Monitoring Well	Model Layer	Mean Error	Mean Absolute Error	Mean Absolute Error Category
C1	3	0	0	0-200
C2	3	519	519	500-2000
C3	3	98	124.5	0-200
C4	5	1.7	1.7	0-200
C5	3	897.6	897.6	500-2000
C9	3	-5.9	6	0-200
C10	5	80.4	80.4	0-200
C12	3	178	178	0-200
C13	3	-555	563.7	500-2000
C14	3	-882.6	882.6	500-2000
C15-D	3	-1.1	1.1	0-200
C15-S	3	-3.1	3.1	0-200
C16	3	0.9	0.9	0-200
C17-D	3	-0.2	0.4	0-200
C17-S	3	-0.5	0.5	0-200
C18	3	56.9	56.9	0-200
FWC-11	3	693.6	693.6	500-2000
FWS-12	1	218.1	218.1	200-500
FWS-13	1	745.7	745.7	500-2000
RWC-1	3	251.9	252.6	200-500
RWC-2	3	-1816.4	1816.4	500-2000
RWS-1A	1	207	207	200-500
RWS-2A	1	301	301	200-500
RWS-3A	1	-83.3	136.4	0-200
RWS-4A	1	-1645.3	1771.3	500-2000
S1	1	-0.5	0.5	0-200
S2	1	-73.8	111.6	0-200
S3	1	356.5	358.6	200-500
S4	1	45.3	45.3	0-200
S5	1	527.7	527.7	500-2000
S6	1	5	5	0-200
S7	1	25.4	25.4	0-200
S8	1	8.7	8.7	0-200
S9	1	26.4	26.4	0-200
S10	1	442.6	442.6	200-500
S11	1	0	0	0-200
S14	1	7.7	7.7	0-200

N:\GIS\Projects\ Projects 4000 to 4999\CF4265 CampLejeuneGroundwater BLG\Production Maps\US Phase1 Rebuttal\US Phase1 Rebuttal.aprx Layout Name: Figure A1 PCE 1994 Contour 1/10/2025 11:54 AM

ATSDR Model PCE Contours (µg/L)



Updated Model PCE Contours (µg/L)



Historical Water Supply Area

- Holcomb Boulevard
- Tarawa Terrace
- Simulated Potentiometric Contour (ft)
- Model Boundary
- ABC One-Hour Cleaner

PCE Concentration (µg/L)

- 1 to 5
- Greater than 5 to 50
- Greater than 50 to 500
- Greater than 500 to 1,000
- Greater than 1,000 to 5,000

0 1,000 2,000
Feet

N

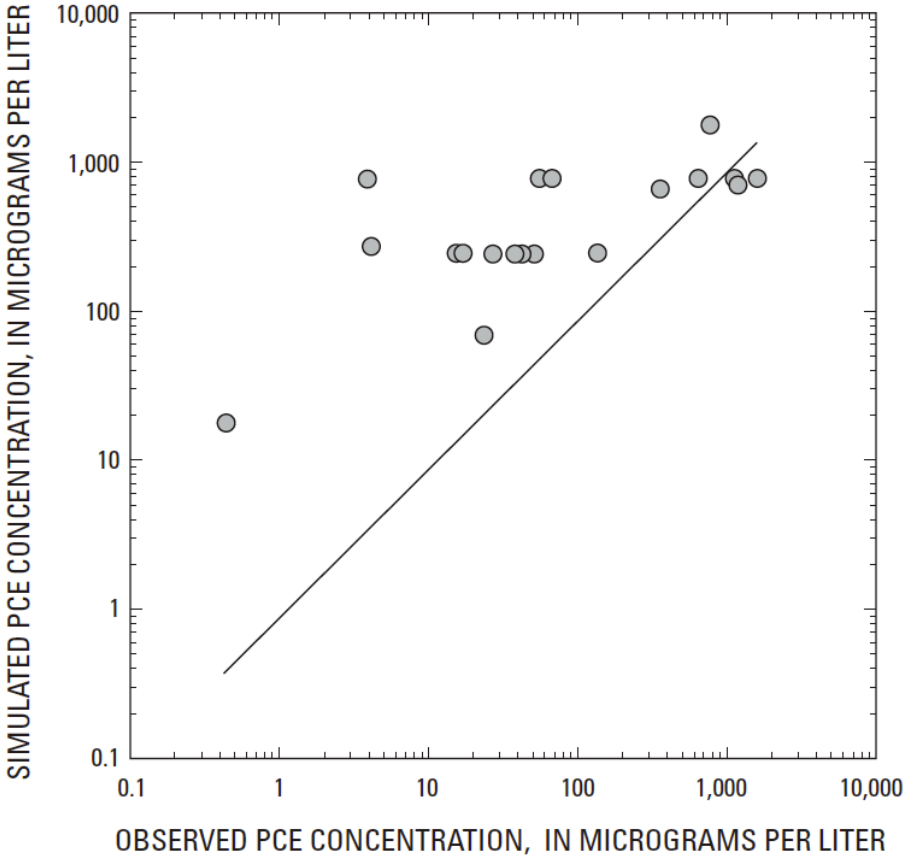
Notes:
PCE concentrations for model layer 1 are shown for both the ATSDR Model and the Updated Model.
- ATSDR Model PCE Contours were simulated in the original MT3DMS model and copied directly over from Figure F23 (Faye et al. 2007).
- Updated Model PCE Contours were simulated in MT3DMS and exported from GMS software.
- A visual comparison suggests that the updated model is accurately representing the results from the ATSDR model.

ATSDR = Agency for Toxic Substances and Disease Registry
GMS = Groundwater Modeling System
PCE = tetrachloroethylene

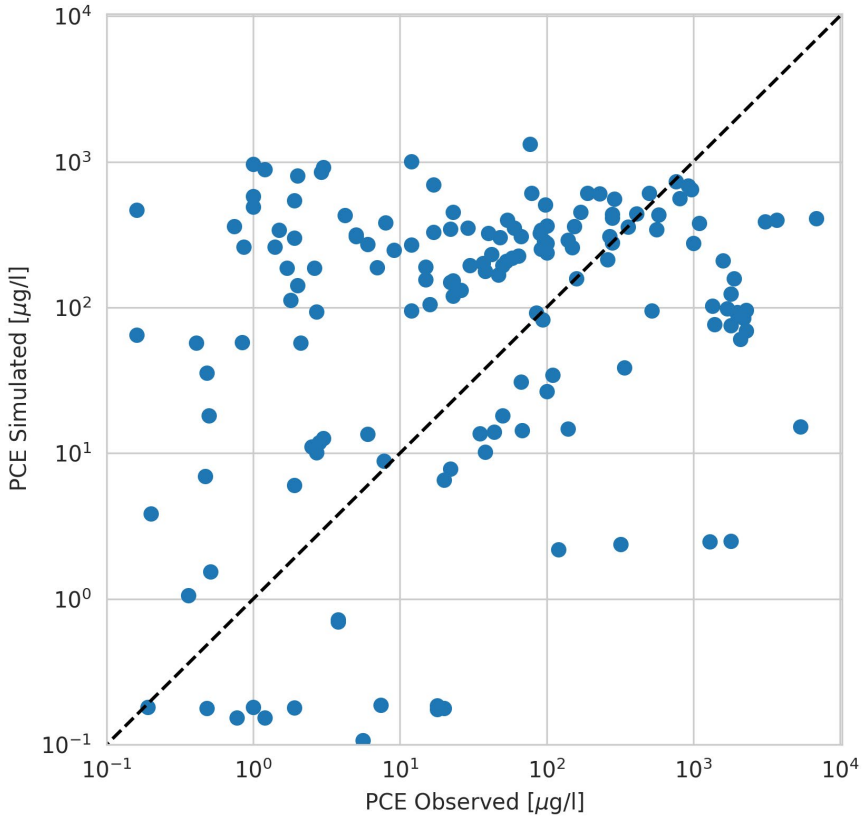
integral consulting inc.

Figure A1.
Comparison of Original Model-Simulated PCE Concentrations (Compare to Figure 2 in Post-Audit Report) to Updated Model-Simulated PCE Concentrations
Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit
Appendix A

Original Model



Updated Post-Audit Report

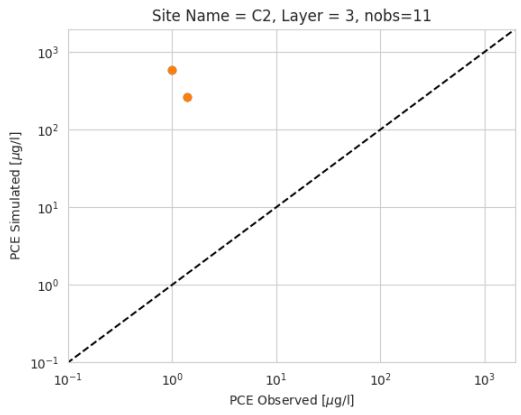


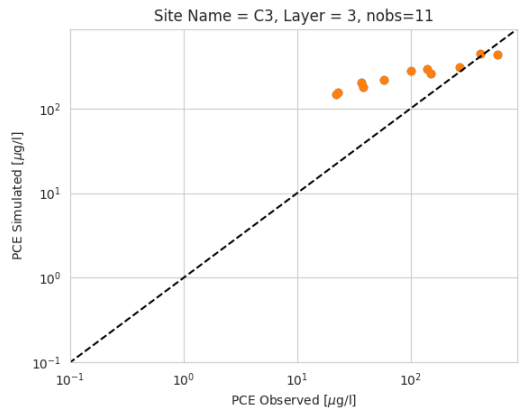
Notes:
The Original Model results are from (Maslia et al. 2007).
The Post-Audit results were shown in Figure 5 of Jones and Davis (2024).

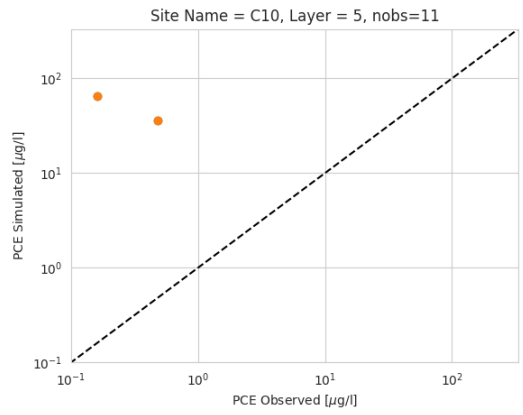
PCE = tetrachloroethylene

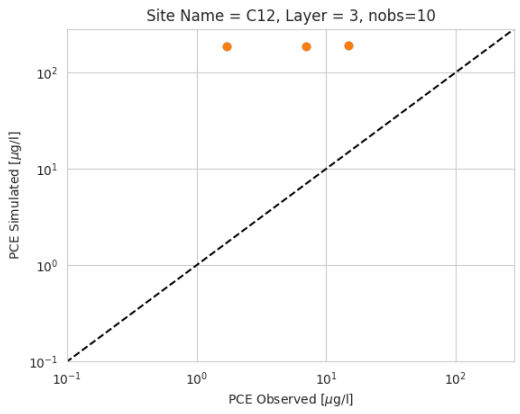
integral

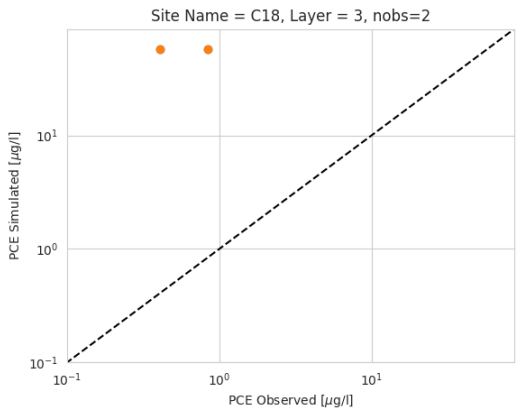
Figure A2.
Simulated vs. Observed PCE Concentrations
(Compare to Figure 6 in Post-Audit Report)
Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit
Appendix A

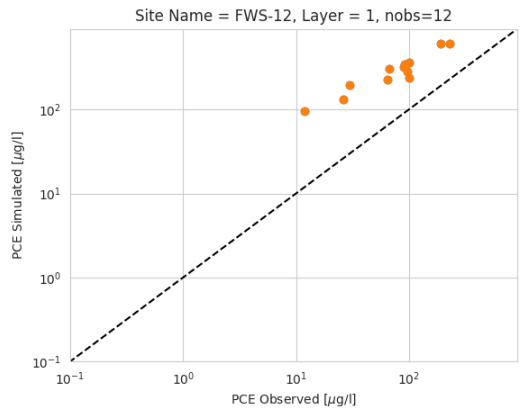


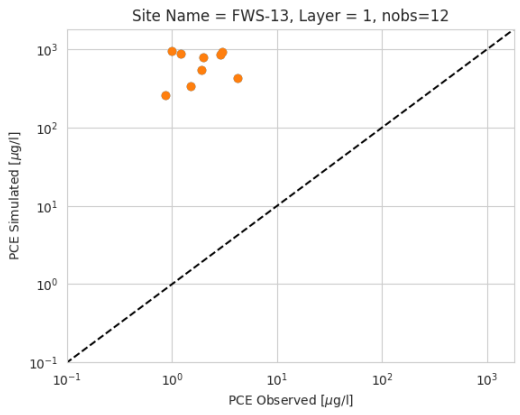


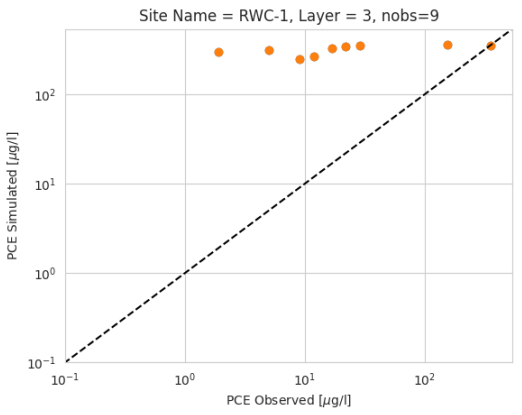


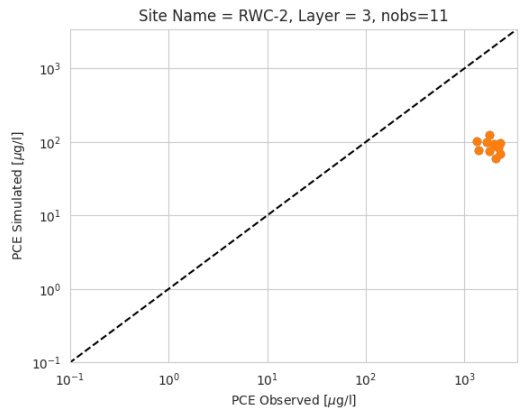


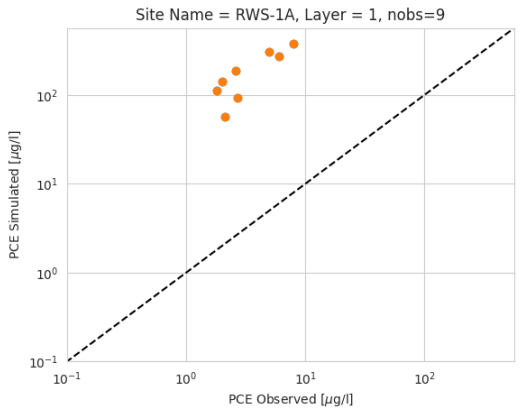


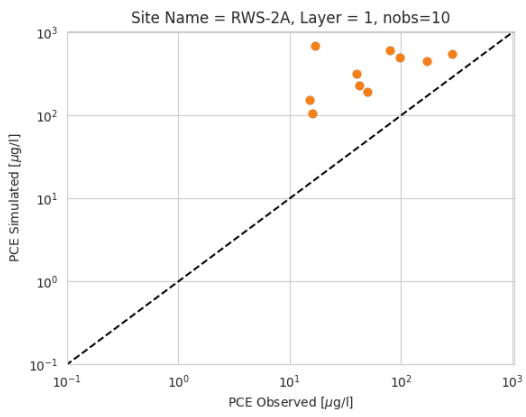


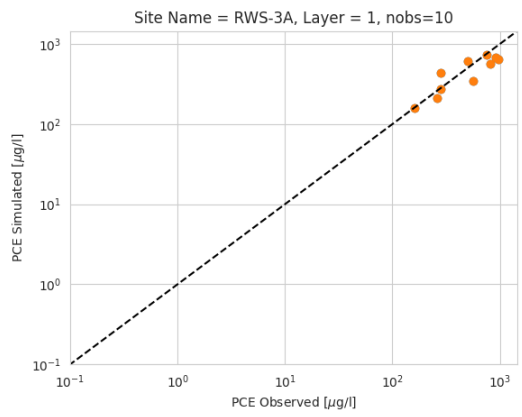


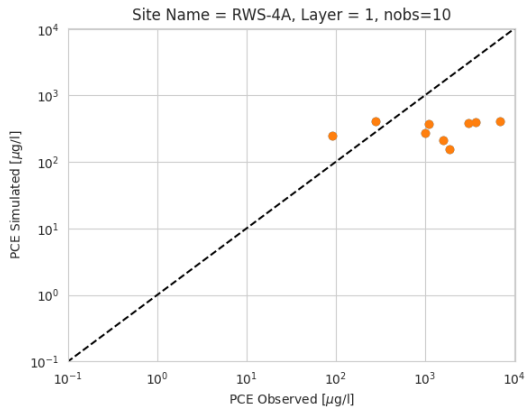


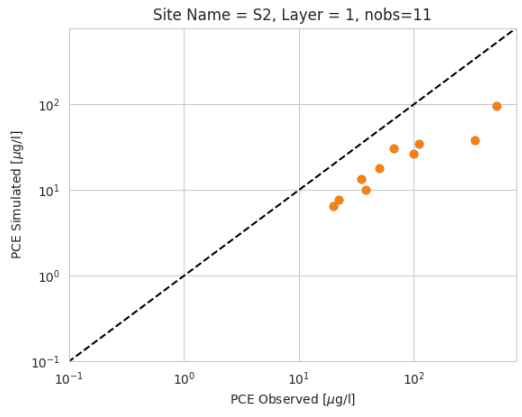


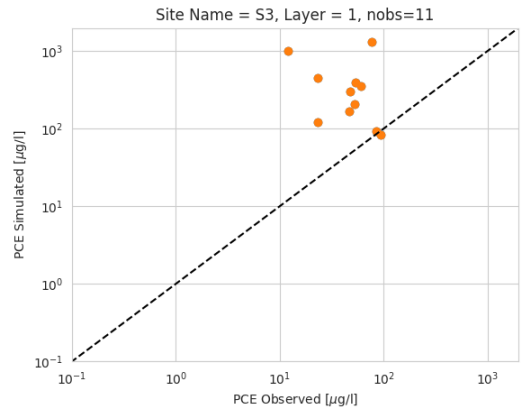


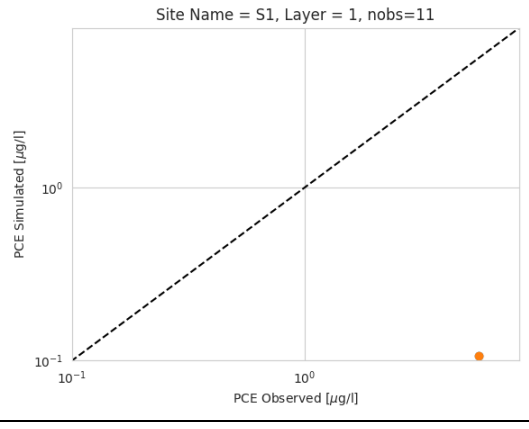












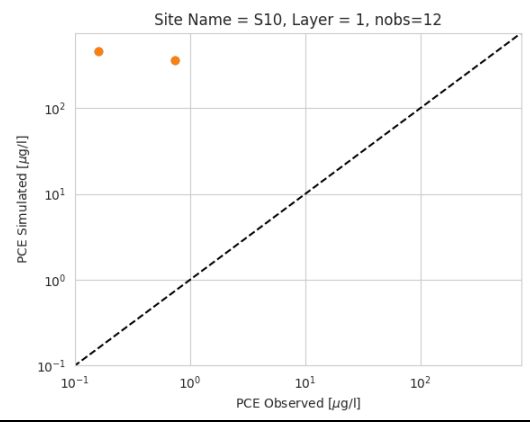
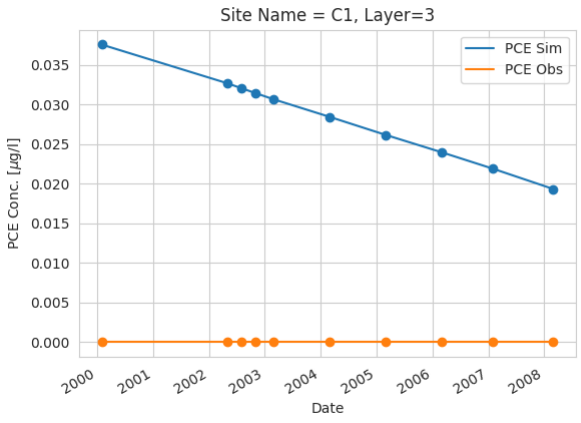
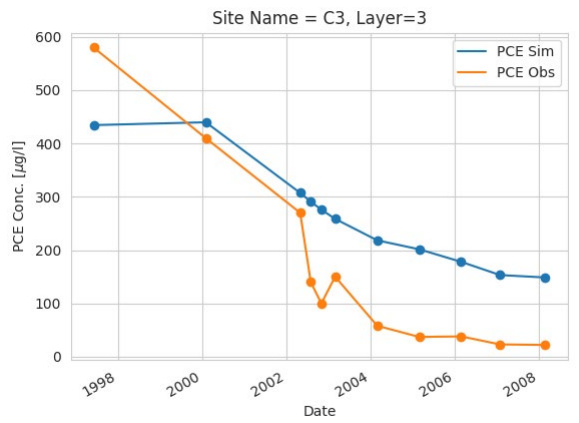
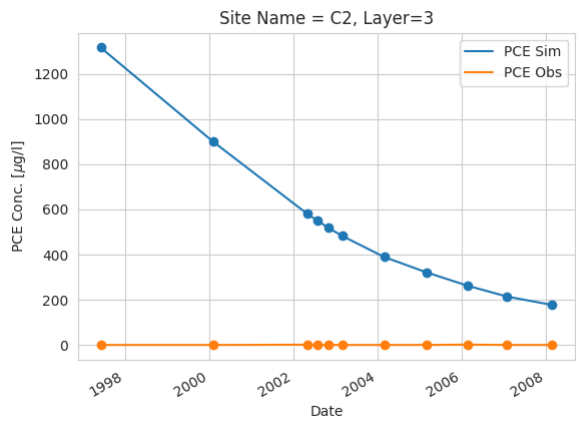
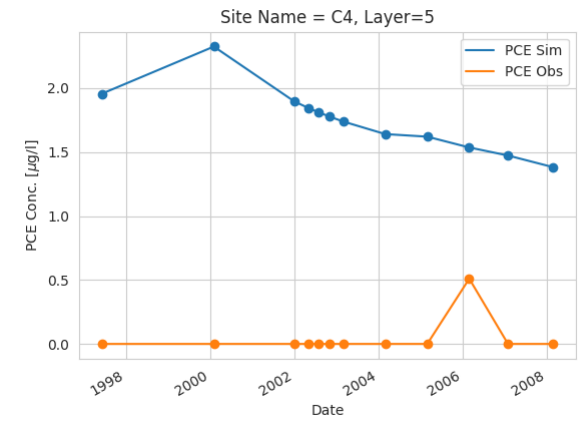


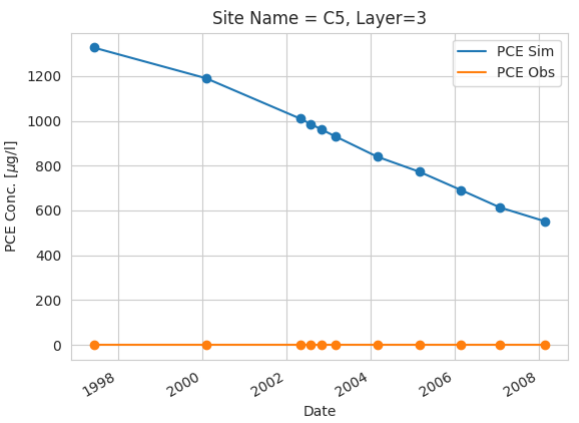
Figure A3.
Simulated vs. Observed PCE Concentrations
(Compare to Figure 7 in Post-Audit Report)
Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit
Appendix A

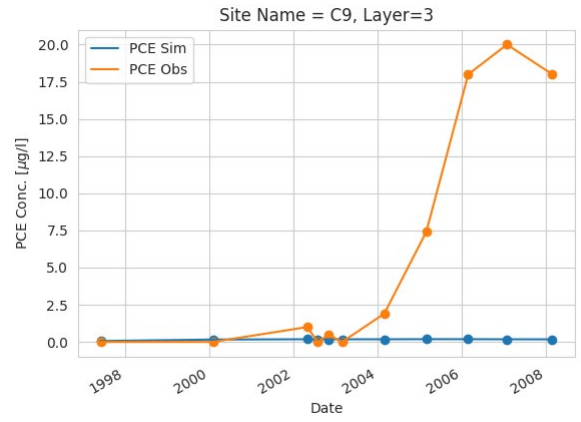


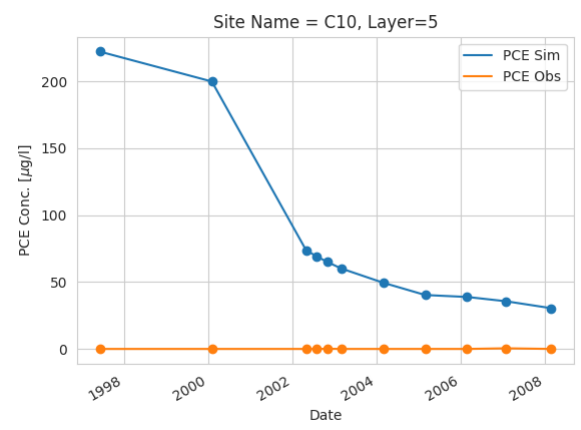


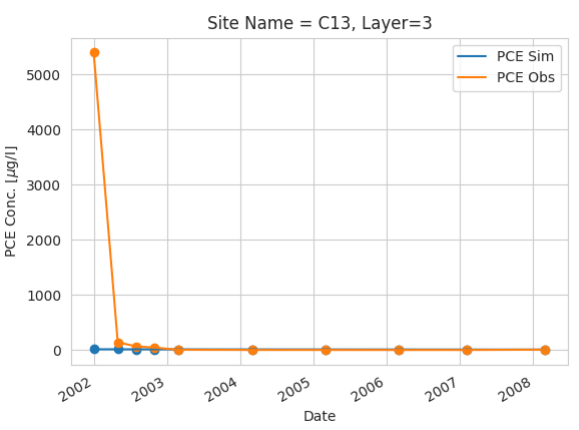


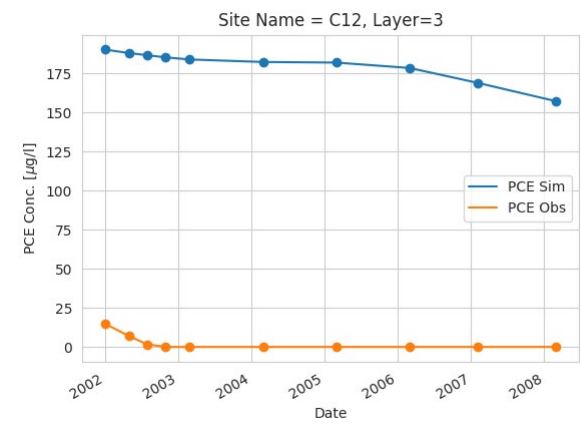


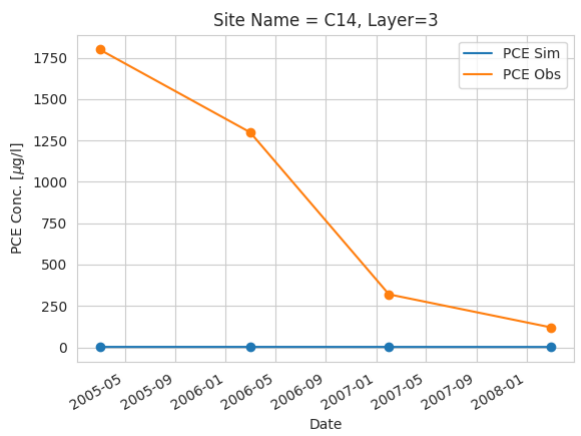


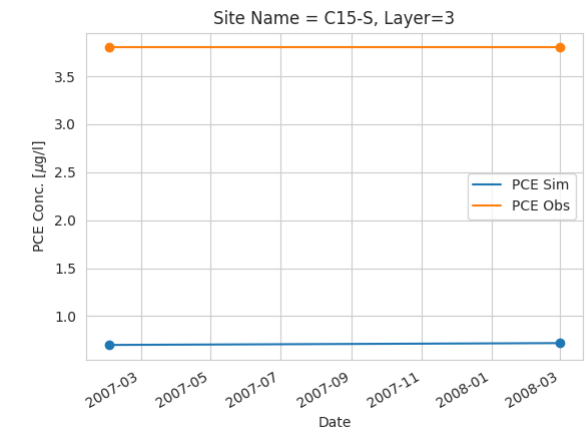


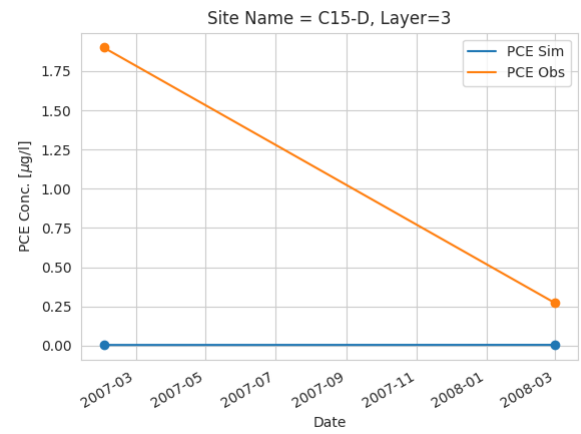


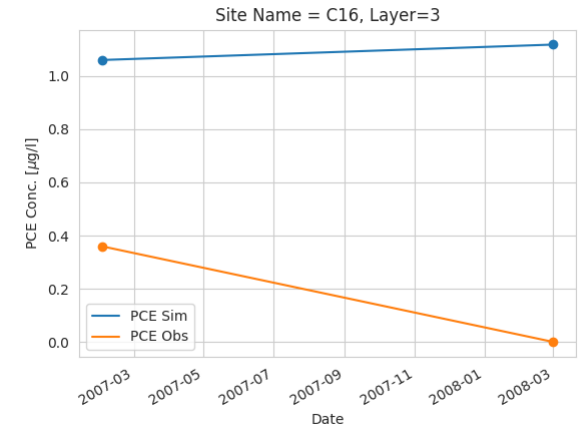


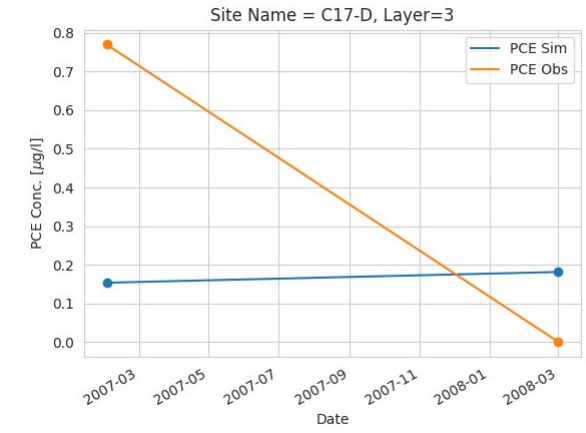


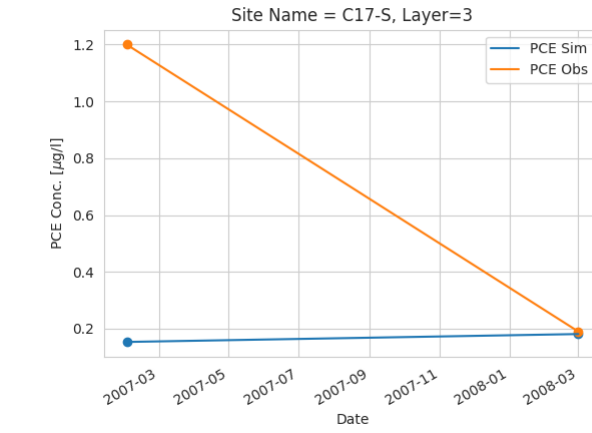


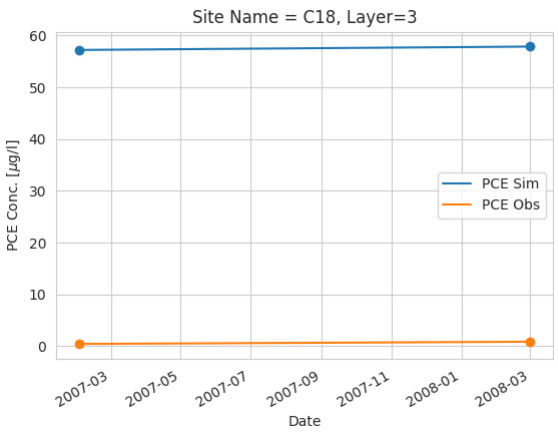


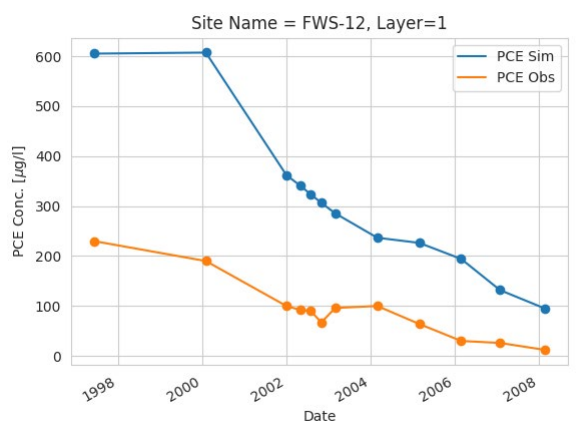












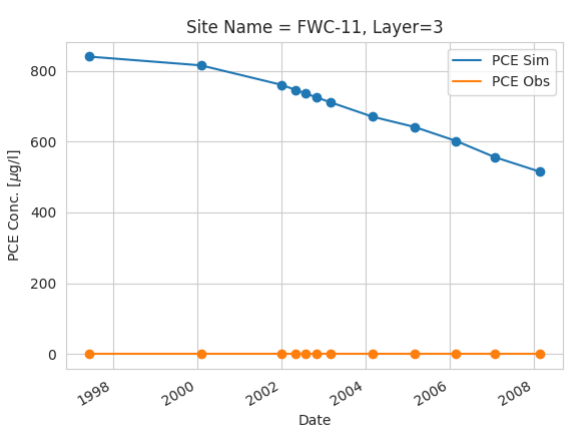
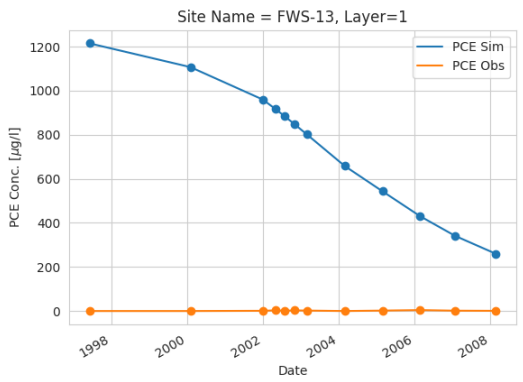
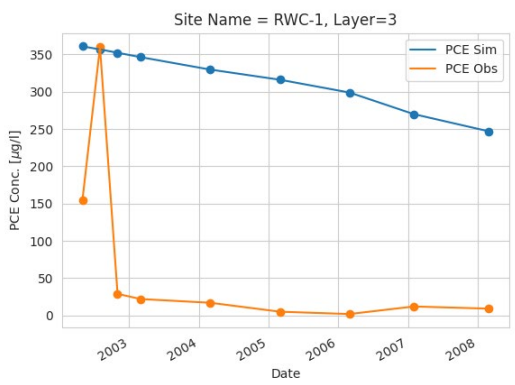
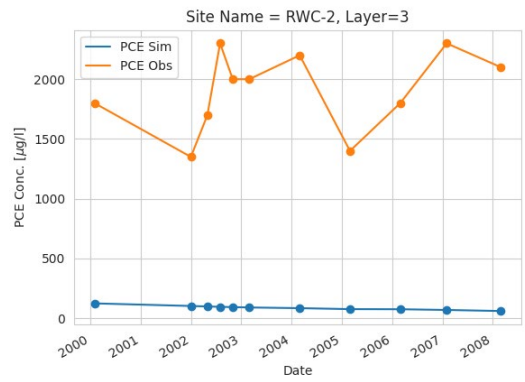
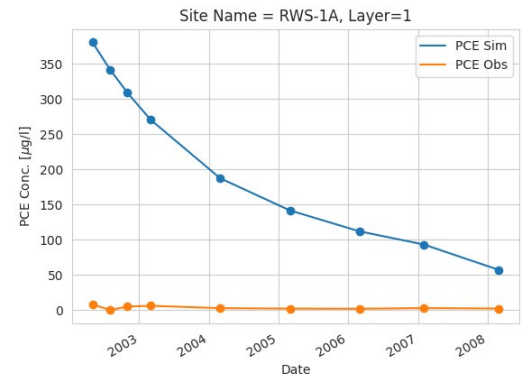


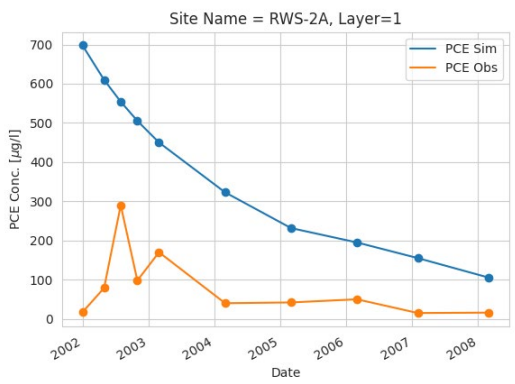
Figure A4.
Time Series Plots of Simulated and Observed PCE Concentrations (Compare to Figure 8 in Post-Audit Report)
Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit
Appendix A

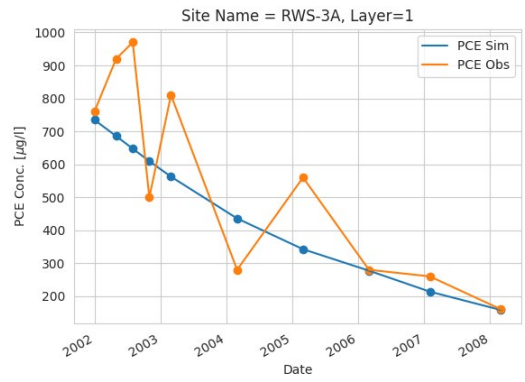


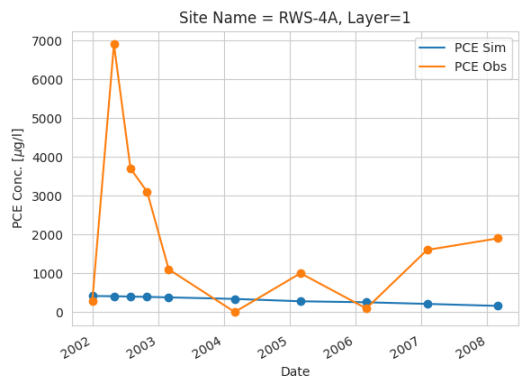


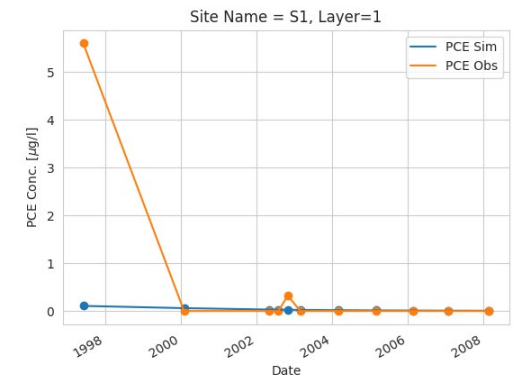


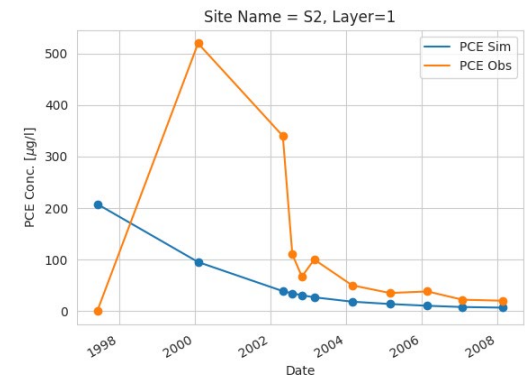


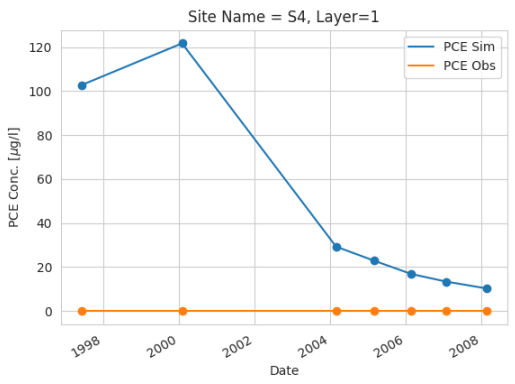


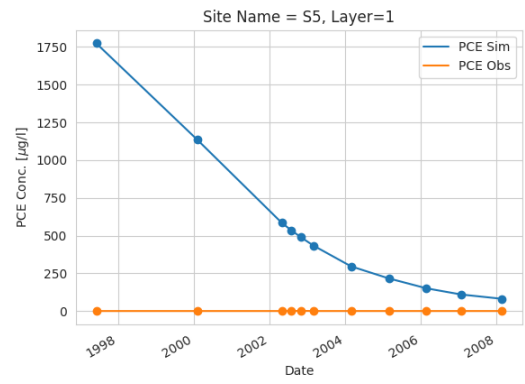


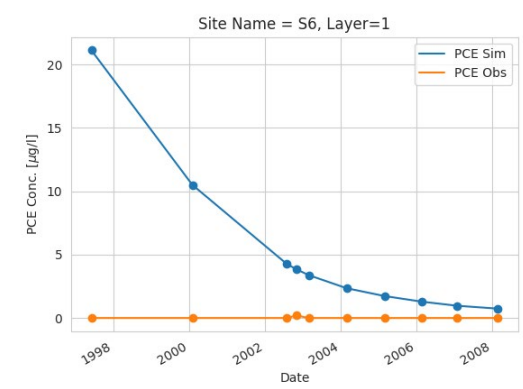


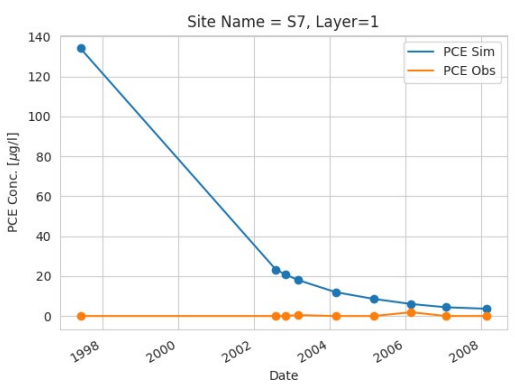


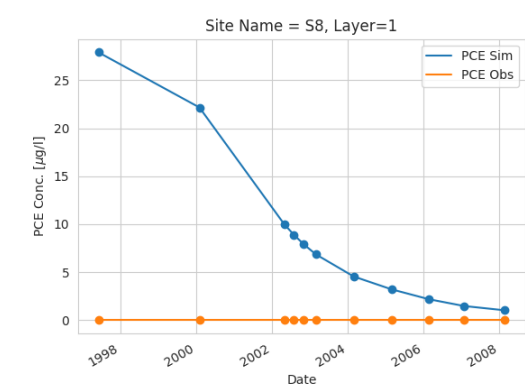


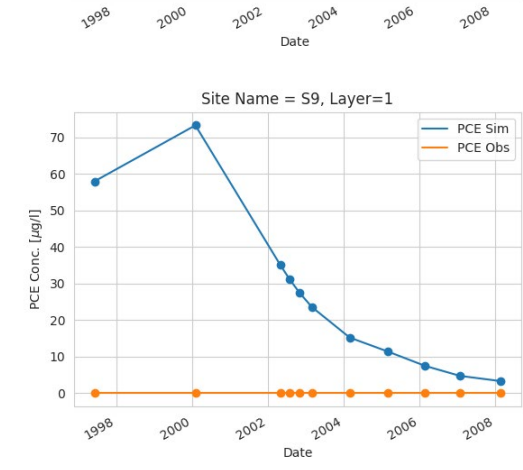


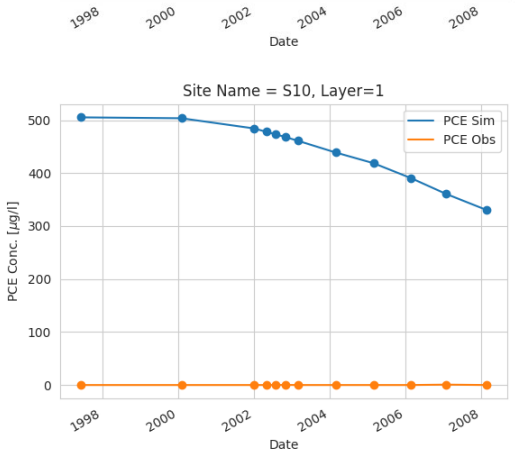


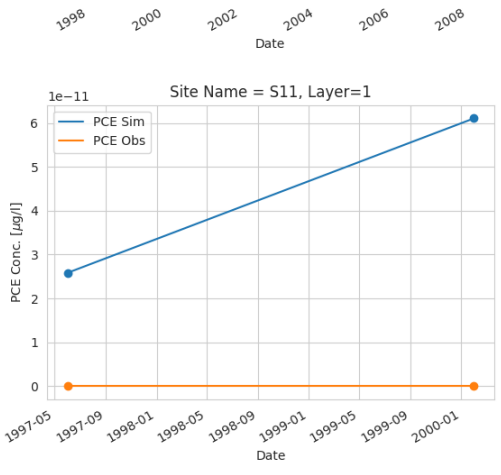












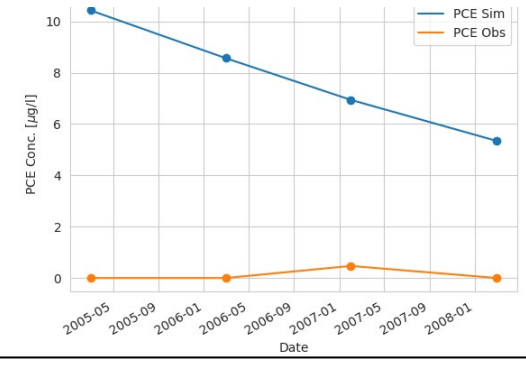


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Figure A4.
Time Series Plots of Simulated and Observed PCE Concentrations
(Compare to Figure 8 in Post-Audit Report)
Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit
Appendix A

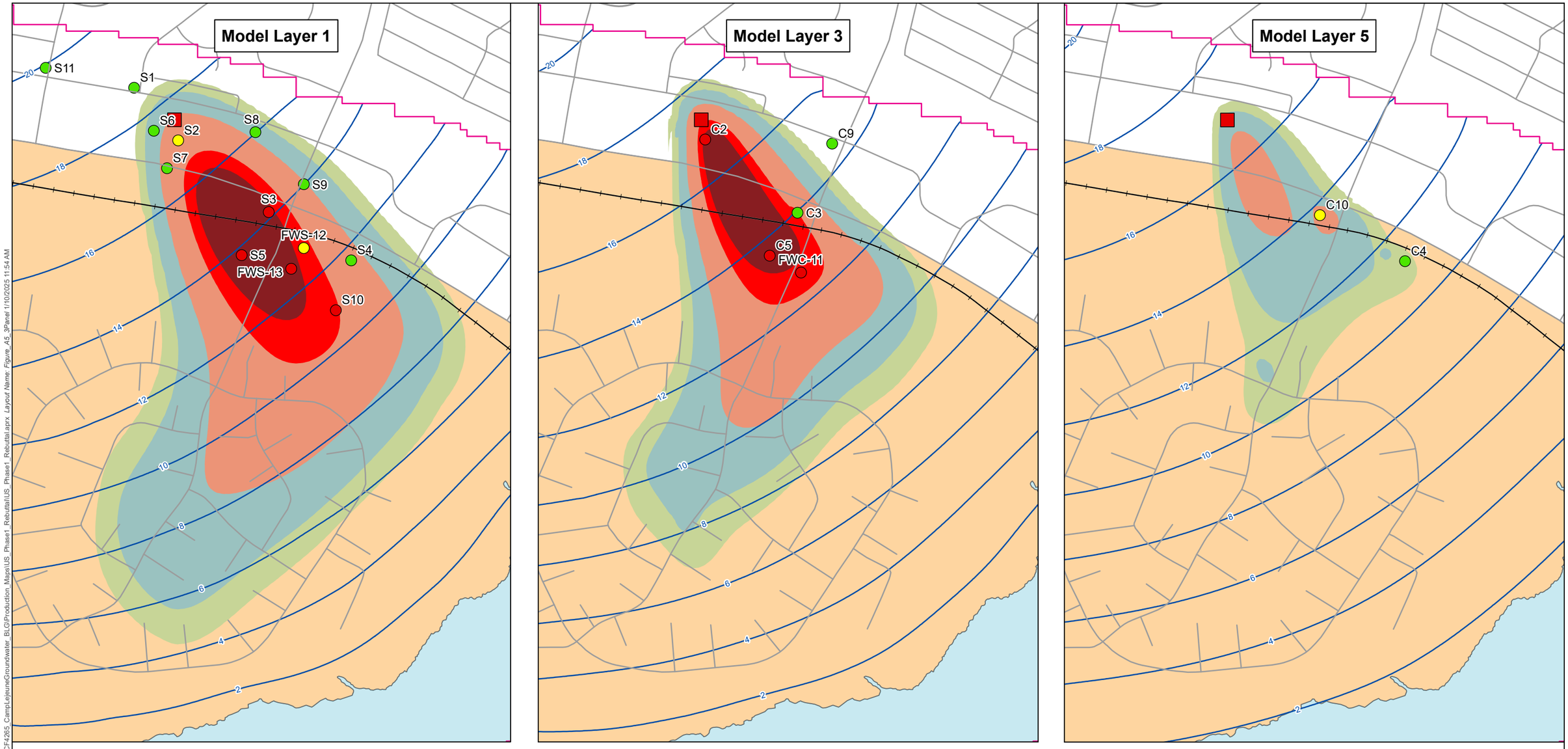

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Figure A5.
Simulated PCE Concentration for Three Model Layers
Compared to Measured Values, June 1997
(Compare to Figure 9 in Post-Audit Report)
Rebuttal Report Regarding Tarawa Terrace Flow and
Transport Model Post-Audit
Appendix A

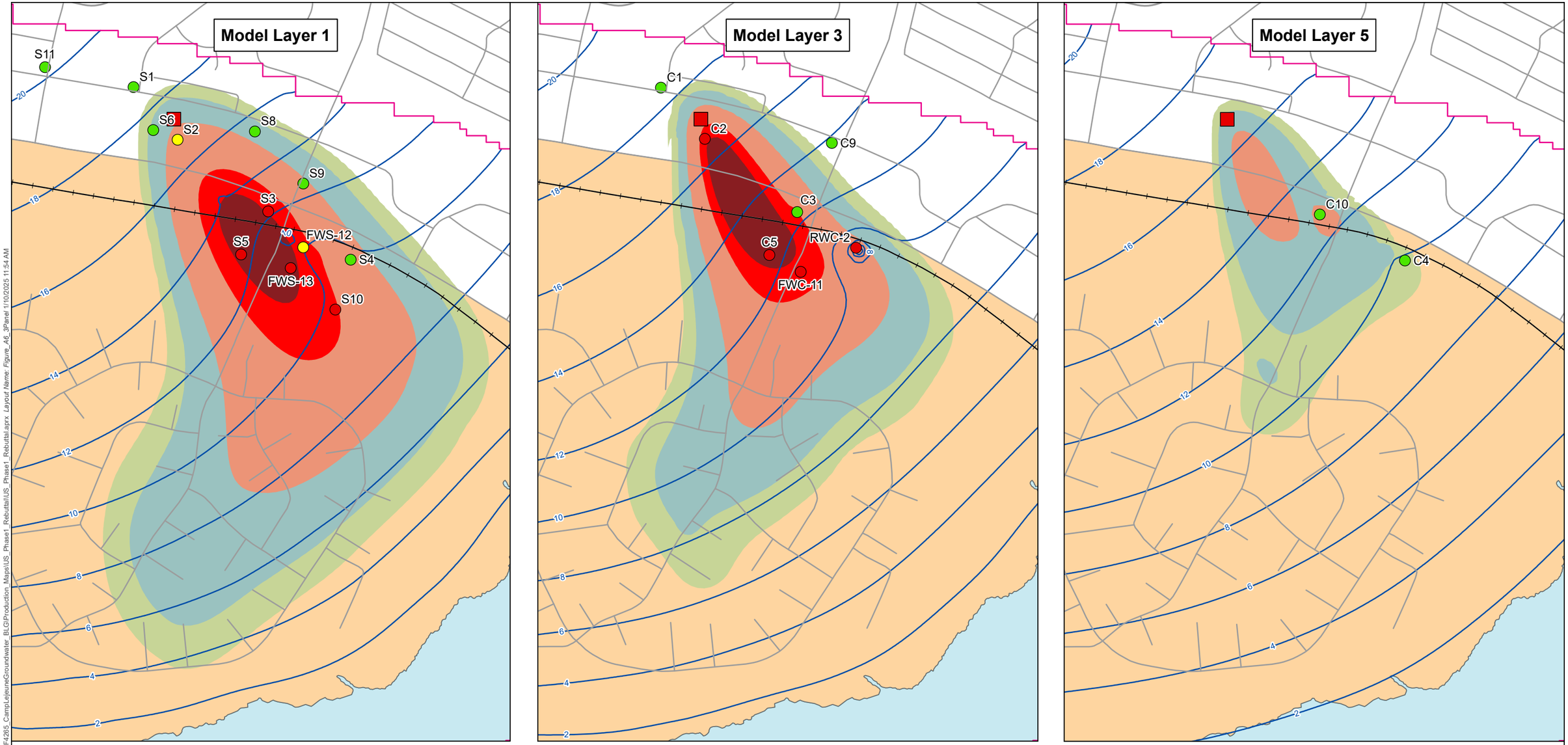

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Figure A6.
Simulated PCE Concentration for Three Model Layers
Compared to Measured Values, February 2000
(Compare to Figure 10 in Post-Audit Report)
Rebuttal Report Regarding Tarawa Terrace Flow and
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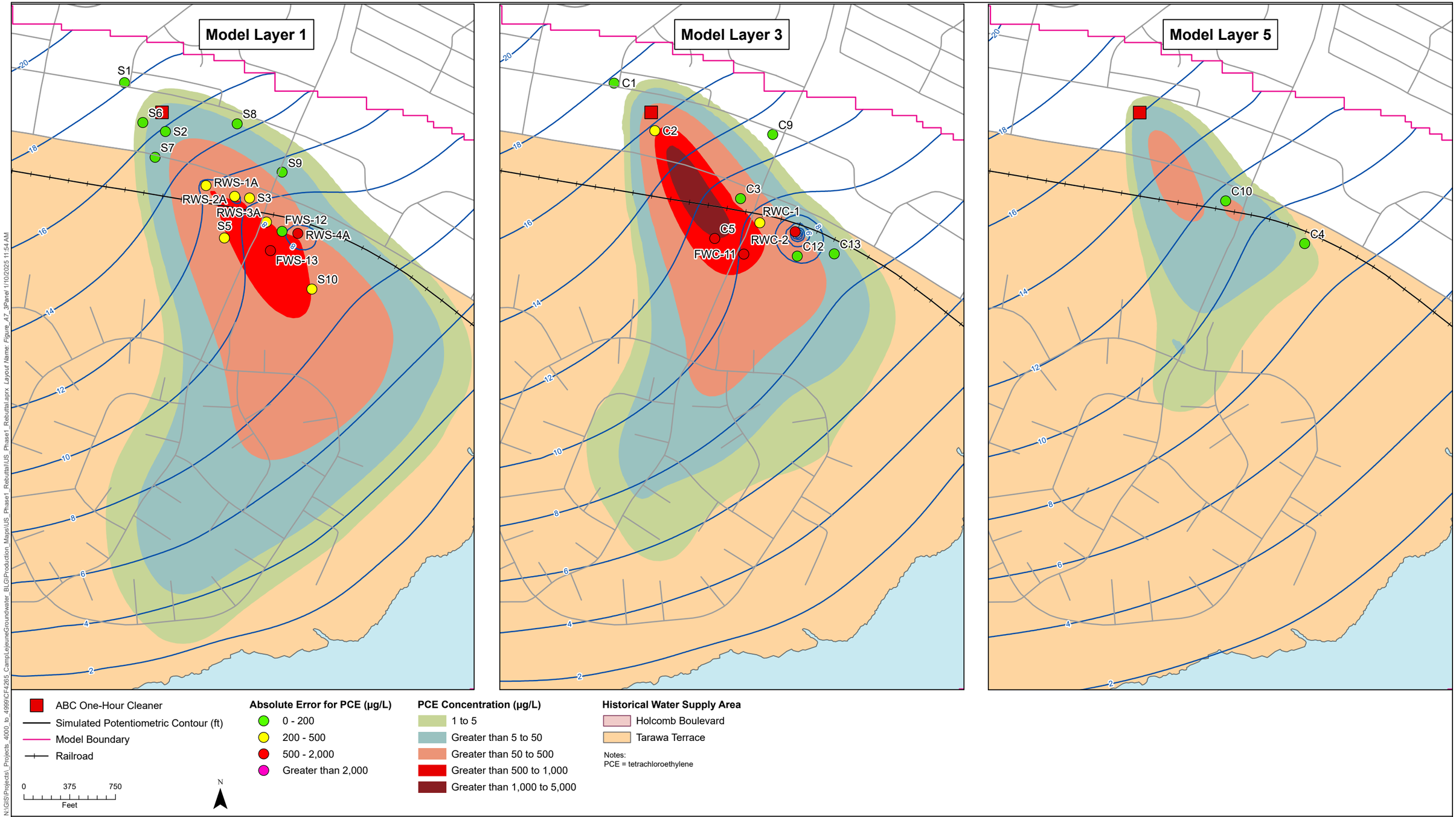

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Figure A7.
Simulated PCE Concentration for Three Model Layers
Compared to Measured Values, March 2003
(Compare to Figure 11 in Post-Audit Report)
Rebuttal Report Regarding Tarawa Terrace Flow and
Transport Model Post-Audit
Appendix A

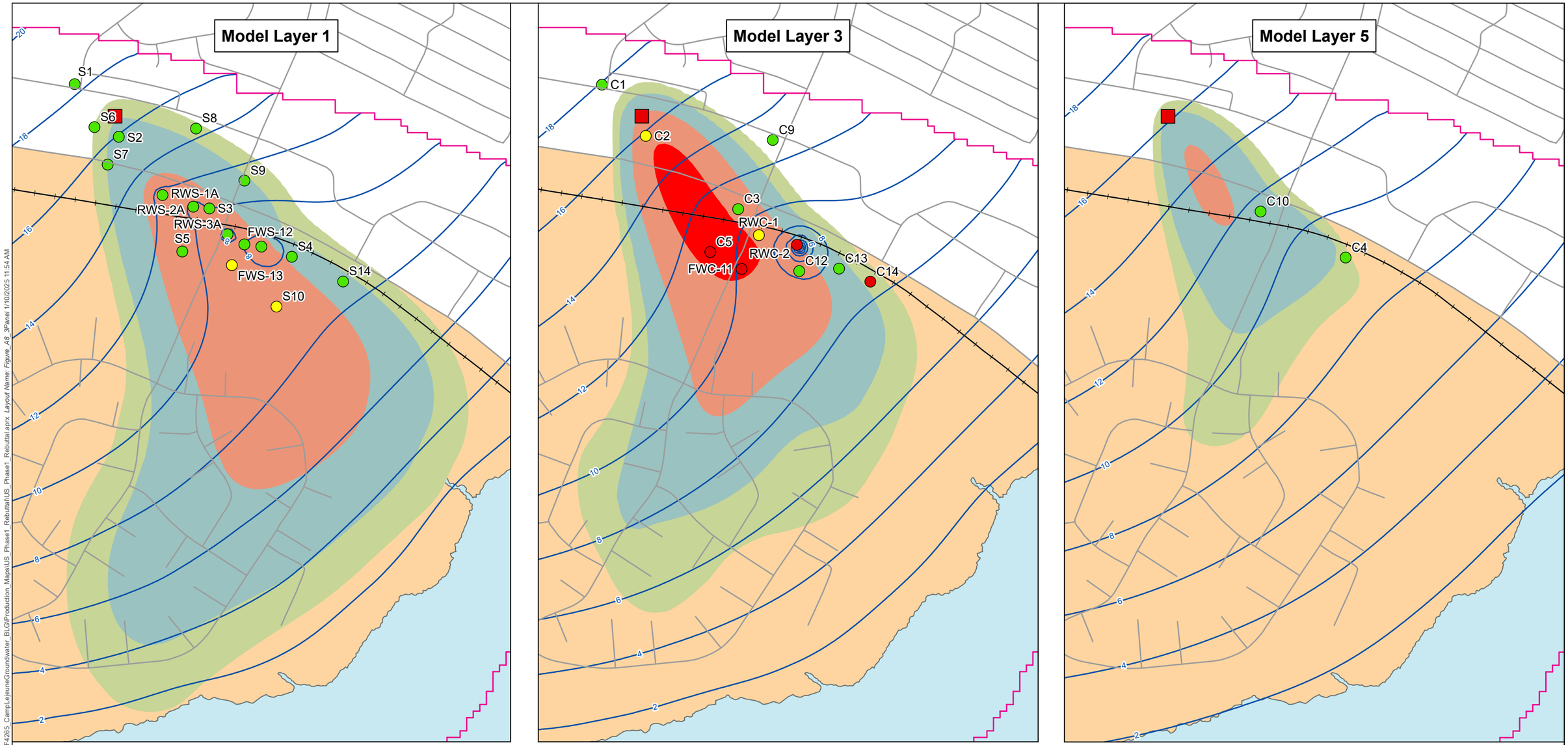

Figure A8.
Simulated PCE Concentration for Three Model Layers
Compared to Measured Values, March 2006
(Compare to Figure 12 in Post-Audit Report)
Rebuttal Report Regarding Tarawa Terrace Flow and
Transport Model Post-Audit
Appendix A

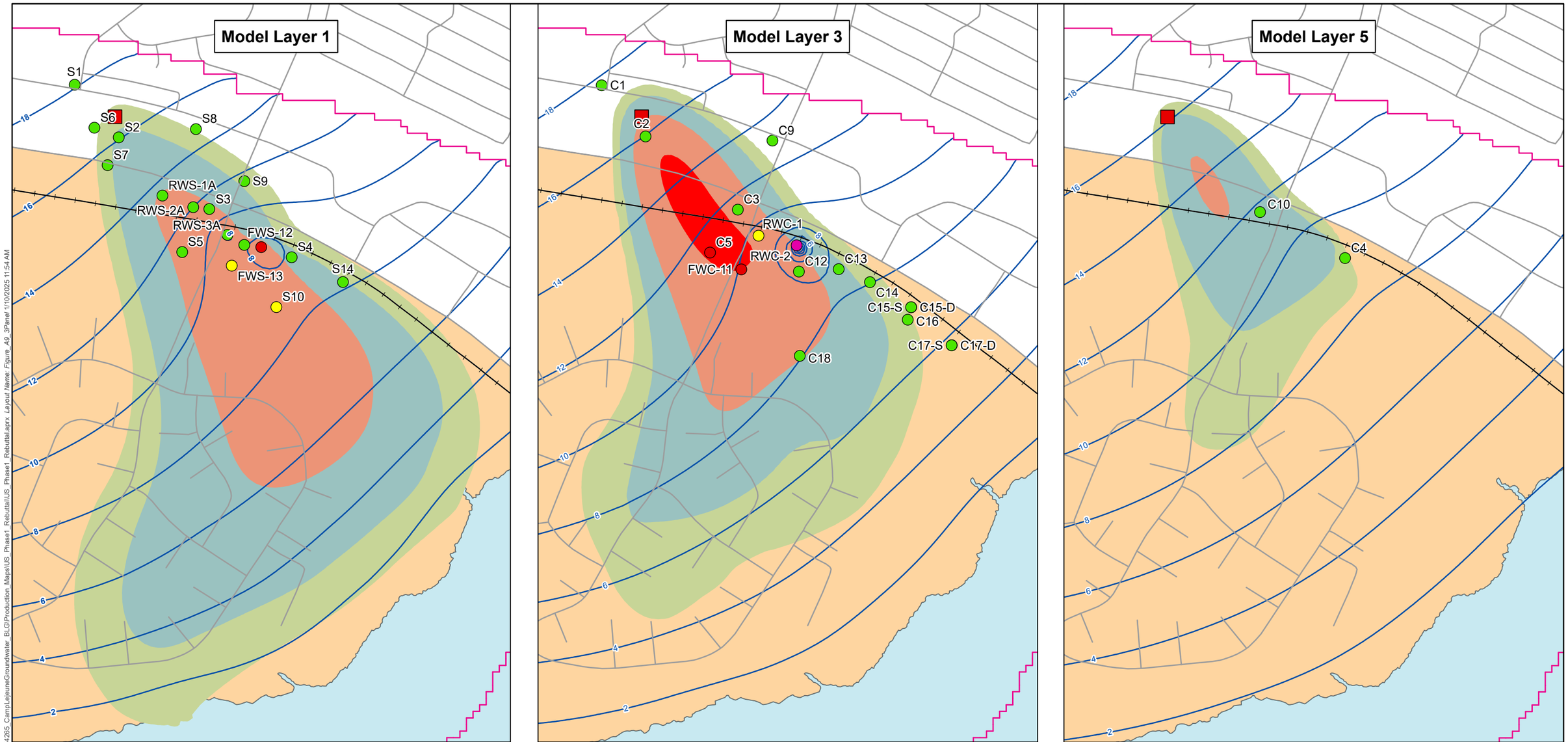

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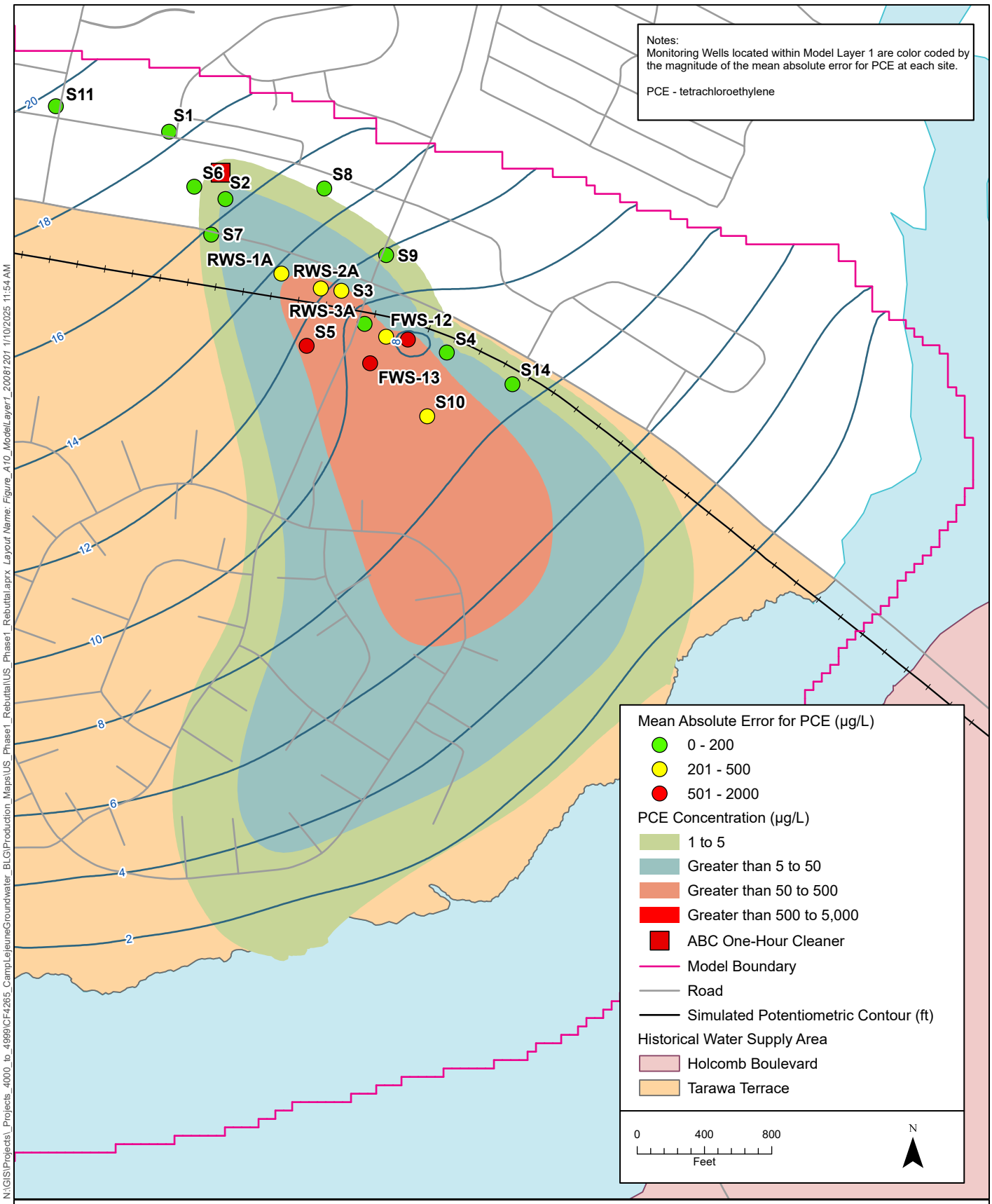
Figure A9.
Simulated PCE Concentration for Three Model Layers
Compared to Measured Values, March 2008
(Compare to Figure 13 in Post-Audit Report)
Rebuttal Report Regarding Tarawa Terrace Flow and
Transport Model Post-Audit
Appendix A



integral consulting inc.

Figure A10.
Simulated PCE Plume for December 2008 for Model Layer 1
(Compare to Figure 14 in Post-Audit Report)
Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit
Appendix A

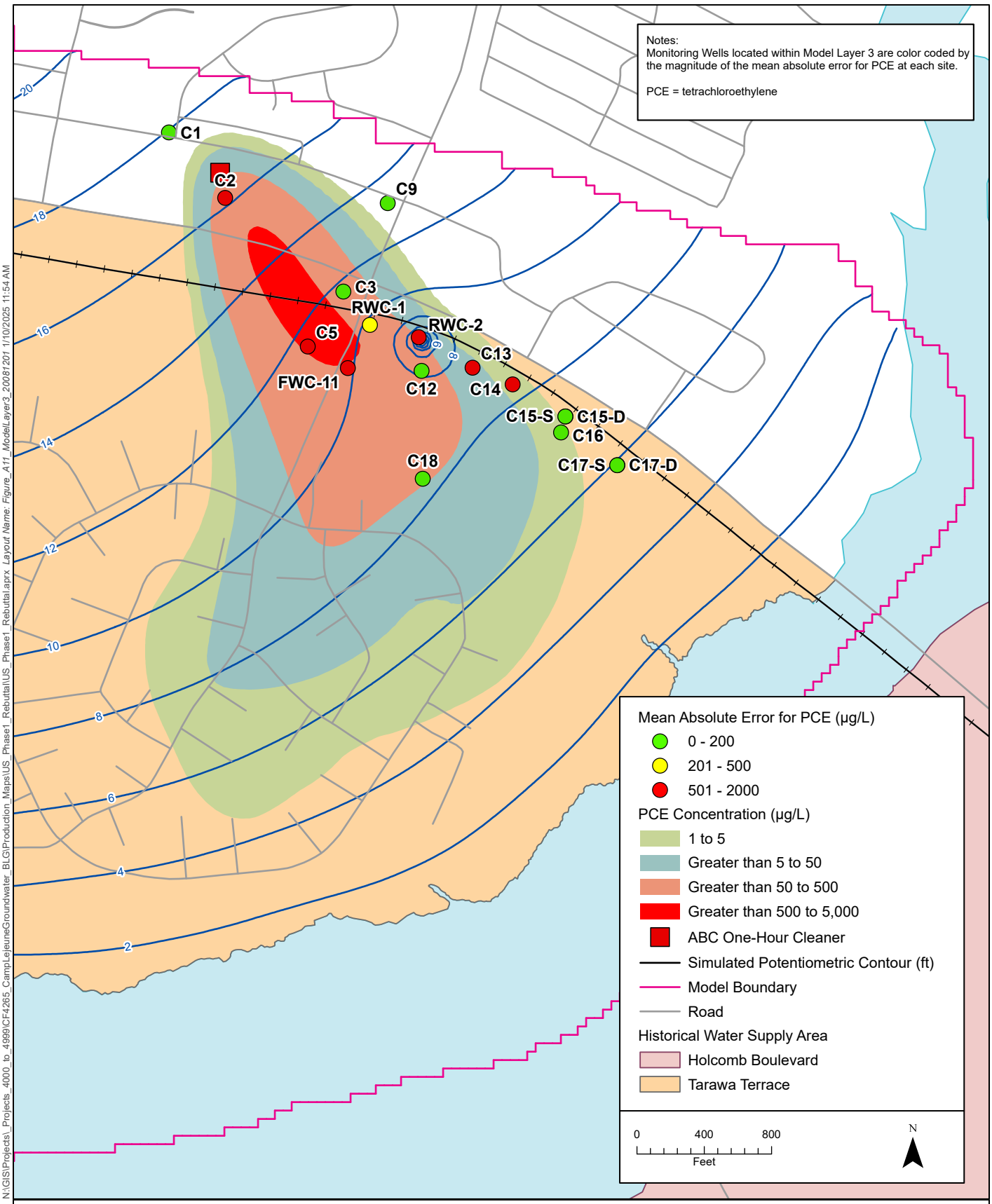


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Figure A11.
Simulated PCE Plume for December 2008 for Model Layer 3
(Compare to Figure 15 in Post-Audit Report)
Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit
Appendix A

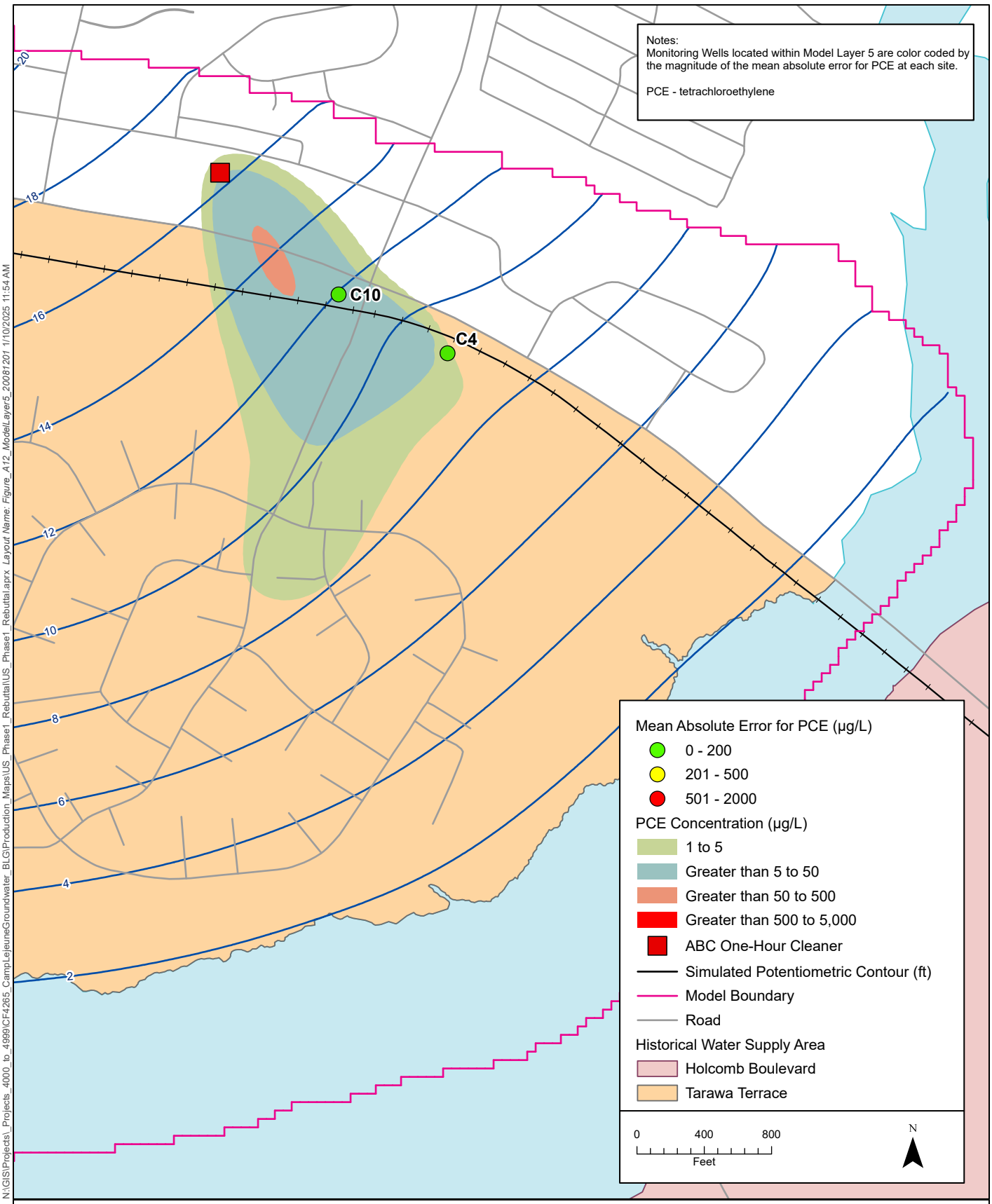

Figure A12.
Simulated PCE Plume for December 2008 for Model Layer 5
(Compare to Figure 16 in Post-Audit Report)
Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit
Appendix A

January 2025 Rebuttal - Expert Report of Dr. Norm Jones and Jeffrey Davis

Materials Considered

January 21, 2025

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93. CLJA_WATERMODELING_01-0000058439-CLJA_WATERMODELING_01-0000058439

94. CLJA_WATERMODELING_01-0000058440-CLJA_WATERMODELING_01-0000058448

95. CLJA_WATERMODELING_01-0000067692-CLJA_WATERMODELING_01-0000067692

96. CLJA_WATERMODELING_01-0000067693-CLJA_WATERMODELING_01-0000067695

97. CLJA_WATERMODELING_01-0000136165-CLJA_WATERMODELING_01-0000136279

98. CLJA_WATERMODELING_01-0000136286-CLJA_WATERMODELING_01-0000136319

99. CLJA_WATERMODELING_01-0000136320-CLJA_WATERMODELING_01-0000136330

100. CLJA_WATERMODELING_01-0000136346-CLJA_WATERMODELING_01-0000136416

101. CLJA_WATERMODELING_01-0000205652-CLJA_WATERMODELING_01-0000205674

102. CLJA_WATERMODELING_01-0000840243-CLJA_WATERMODELING_01-0000840246

103. CLJA_WATERMODELING_01-0000840247-CLJA_WATERMODELING_01-0000840250

104. CLJA_WATERMODELING_07-0000440066-CLJA_WATERMODELING_07-0000440439

105. CLJA_WATERMODELING_07-0000441159-CLJA_WATERMODELING_07-0000441495

106. CLJA_WATERMODELING_07-0000441791-CLJA_WATERMODELING_07-0000442145

107. CLJA_WATERMODELING_07-0000461898-CLJA_WATERMODELING_07-0000461902

108. CLJA_WATERMODELING_07-0000462245-CLJA_WATERMODELING_07-0000462249

109. CLJA_WATERMODELING_07-0001197480-CLJA_WATERMODELING_07-0001197563

110. CLJA_WATERMODELING_09-0000084196-CLJA_WATERMODELING_09-0000084557

Tarawa Terrace Model Input Files

111. CLJA_WATERMODELING_01-0000489859-CLJA_WATERMODELING_01-0000489859

112. CLJA_WATERMODELING_01-0000489861-CLJA_WATERMODELING_01-0000489861

113. CLJA_WATERMODELING_01-0000489863-CLJA_WATERMODELING_01-0000489863

114. CLJA_WATERMODELING_01-0000489862-CLJA_WATERMODELING_01-0000489862

115. CLJA_WATERMODELING_01-0000489860-CLJA_WATERMODELING_01-0000489860

116. CLJA_WATERMODELING_01-0000489864-CLJA_WATERMODELING_01-0000489864

117. CLJA_WATERMODELING_01-0000489857-CLJA_WATERMODELING_01-0000489857

118. CLJA_WATERMODELING_01-0000489858-CLJA_WATERMODELING_01-0000489858

119. CLJA_WATERMODELING_01-0000489817-CLJA_WATERMODELING_01-0000489817

120. CLJA_WATERMODELING_01-0000489819-CLJA_WATERMODELING_01-0000489819

121. CLJA_WATERMODELING_01-0000489814-CLJA_WATERMODELING_01-0000489814

122. CLJA_WATERMODELING_01-0000489815-CLJA_WATERMODELING_01-0000489815

123. CLJA_WATERMODELING_01-0000489821-CLJA_WATERMODELING_01-0000489821

124. CLJA_WATERMODELING_01-0000489848-CLJA_WATERMODELING_01-0000489848

125. CLJA_WATERMODELING_01-0000489818-CLJA_WATERMODELING_01-0000489818

126. CLJA_WATERMODELING_01-0000489820-CLJA_WATERMODELING_01-0000489820

127. CLJA_WATERMODELING_01-0000489816-CLJA_WATERMODELING_01-0000489816

128. CLJA_WATERMODELING_01-0000489852-CLJA_WATERMODELING_01-0000489852

129. CLJA_WATERMODELING_01-0000489855-CLJA_WATERMODELING_01-0000489855

130. CLJA_WATERMODELING_01-0000489851-CLJA_WATERMODELING_01-0000489851

131. CLJA_WATERMODELING_01-0000489853-CLJA_WATERMODELING_01-0000489853

132. CLJA_WATERMODELING_01-0000489854-CLJA_WATERMODELING_01-0000489854

133. CLJA_WATERMODELING_01-0000489850-CLJA_WATERMODELING_01-0000489850

134. CLJA_WATERMODELING_01-0000489849-CLJA_WATERMODELING_01-0000489849

135. CLJA_WATERMODELING_01-0000489856-CLJA_WATERMODELING_01-0000489856

Initial Post-Audit Tarawa Terrace Model Files

136. TTerrace_1951-2008.adv (CL_PLG-EXPERT_DAVIS_0000000001)

137. TTerrace_1951-2008.ba6 (CL_PLG-EXPERT_DAVIS_0000000002)

138. TTerrace_1951-2008.bc6 (CL_PLG-EXPERT_DAVIS_0000000003)

139. TTerrace_1951-2008.btn (CL_PLG-EXPERT_DAVIS_0000000004)

140. TTerrace_1951-2008.dis (CL_PLG-EXPERT_DAVIS_0000000005)

141. TTerrace_1951-2008.drn (CL_PLG-EXPERT_DAVIS_0000000006)

142. TTerrace_1951-2008.dsp (CL_PLG-EXPERT_DAVIS_0000000007)

143. TTerrace_1951-2008.gcg (CL_PLG-EXPERT_DAVIS_0000000008)

144. TTerrace_1951-2008.ghb (CL_PLG-EXPERT_DAVIS_0000000009)

145. TTerrace_1951-2008.lmt6 (CL_PLG-EXPERT_DAVIS_0000000010)

146. TTerrace_1951-2008.mfn (CL_PLG-EXPERT_DAVIS_0000000011)

147. TTerrace_1951-2008.mfw (CL_PLG-EXPERT_DAVIS_0000000012)

148. TTerrace_1951-2008.mtr (CL_PLG-EXPERT_DAVIS_0000000013)

149. TTerrace_1951-2008.mts (CL_PLG-EXPERT_DAVIS_0000000014)

150. TTerrace_1951-2008.oc (CL_PLG-EXPERT_DAVIS_0000000015)

151. TTerrace_1951-2008.pcg (CL_PLG-EXPERT_DAVIS_0000000016)

152. TTerrace_1951-2008.prj (CL_PLG-EXPERT_DAVIS_0000000017)

153. TTerrace_1951-2008.rch (CL_PLG-EXPERT_DAVIS_0000000018)

154. TTerrace_1951-2008.rct (CL_PLG-EXPERT_DAVIS_0000000019)

155. TTerrace_1951-2008.ssm (CL_PLG-EXPERT_DAVIS_0000000020)

156. TTerrace_1951-2008.tob (CL_PLG-EXPERT_DAVIS_0000000021)

157. TTerrace_1951-2008.wel (CL_PLG-EXPERT_DAVIS_0000000022)

Updated Post-Audit Tarawa Terrace Model Files

158. TTerrace_1951-2008_1953_r293.ba6 (CL_PLG-EXPERT_DAVIS_0000000206)

159. TTerrace_1951-2008_1953_r293.bc6 (CL_PLG-EXPERT_DAVIS_0000000207)

160. TTerrace_1951-2008_1953_r293.dis (CL_PLG-EXPERT_DAVIS_0000000208)

161. TTerrace_1951-2008_1953_r293.drn (CL_PLG-EXPERT_DAVIS_0000000209)

162. TTerrace_1951-2008_1953_r293.ghb (CL_PLG-EXPERT_DAVIS_0000000210)

163. TTerrace_1951-2008_1953_r293.lmt6 (CL_PLG-EXPERT_DAVIS_0000000211)

164. TTerrace_1951-2008_1953_r293.mfn (CL_PLG-EXPERT_DAVIS_0000000212)

165. TTerrace_1951-2008_1953_r293.mfw (CL_PLG-EXPERT_DAVIS_0000000213)

166. TTerrace_1951-2008_1953_r293.oc (CL_PLG-EXPERT_DAVIS_0000000214)

167. TTerrace_1951-2008_1953_r293.pcg (CL_PLG-EXPERT_DAVIS_0000000215)

168. TTerrace_1951-2008_1953_r293.prj (CL_PLG-EXPERT_DAVIS_0000000216)

169. TTerrace_1951-2008_1953_r293.rch (CL_PLG-EXPERT_DAVIS_0000000217)

170. TTerrace_1951-2008_1953_r293.wel (CL_PLG-EXPERT_DAVIS_0000000218)

171. TTerrace_1951-2008_1953_r293.adv (CL_PLG-EXPERT_DAVIS_0000000219)

172. TTerrace_1951-2008_1953_r293.btn (CL_PLG-EXPERT_DAVIS_0000000220)

173. TTerrace_1951-2008_1953_r293.dsp (CL_PLG-EXPERT_DAVIS_0000000221)

174. TTerrace_1951-2008_1953_r293.gcg (CL_PLG-EXPERT_DAVIS_0000000222)

175. TTerrace_1951-2008_1953_r293.mtr (CL_PLG-EXPERT_DAVIS_0000000223)

176. TTerrace_1951-2008_1953_r293.mts (CL_PLG-EXPERT_DAVIS_0000000224)

177. TTerrace_1951-2008_1953_r293.rct (CL_PLG-EXPERT_DAVIS_0000000225)

178. TTerrace_1951-2008_1953_r293.ssm (CL_PLG-EXPERT_DAVIS_0000000226)

179. TTerrace_1951-2008_1953_r293.tob (CL_PLG-EXPERT_DAVIS_0000000227)